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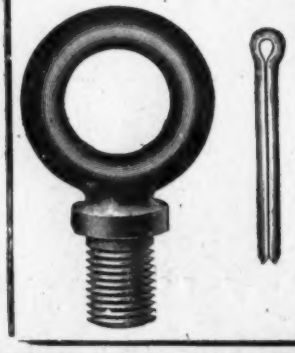

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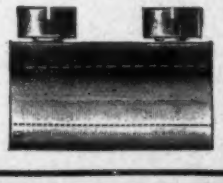

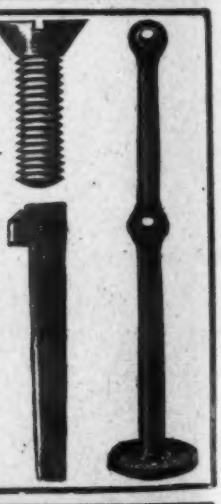

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RAILWAY ELECTRIFICATION RESULTS.

IT is fortunate for us that the American railway authorities have a habit of scattering their electric railway statistics broadcast, for were the British "railway public"—amongst whom we include existing shareholders and that large section of the public which may be regarded as potential investors in railway undertakings—to depend for its information as to working results on the tender mercies of the British railways which have adopted electric traction, we fear that it would fare rather badly. The fact that British railways have in recent years equipped many miles of electrically worked routes is, of course, a general indication that a change was necessary and that electrical working has been found to offer the most satisfactory method of effecting the change. So much is clear to those who think the matter over; but how many do this?

Some valuable data was recently given at a meeting of the New York Railroad Club in regard to the electrical operation of the Chicago, Milwaukee & St. Paul and the Norfolk and Western Railroad's electrified routes. The former is the most extensive project of the kind yet carried out, being the conversion of 440 miles of main line, crossing three mountain ranges, and involving a naturally difficult route with many tunnels. This company, as stated in our issue of March 2nd last, is preparing to electrify another 220-mile stretch of main line, to Seattle, crossing the Cascade Mountains, and situated further west than the existing electrified route, from which it will for the present be separated by an intermediate steam-operated section 200 miles in length. Ultimately, however, it is proposed to electrify the whole western end of the system to the Pacific, some 900 miles in length.

The data concerns the working during the last three months of the years 1915 and 1916 under steam and electric traction respectively, of the 226-mile Rocky Mountain division, between Harlowton and Deer Lodge, which handles both passenger and freight service. Under steam conditions we find 119,330 train engine-miles *plus* 24,752 helper engine-miles, normally requiring 13 engines; under electrical operation 119,237 train engine-miles were run, *no helper engines being required*, and seven locomotives only were employed. The figures do not disclose the true position, however, as freight engines often assisted passenger trains, and it is considered that less than half the number of locomotives will suffice under electrical operation. Per engine, the train miles with steam averaged, roughly, 9,000, as against 17,000 with electricity, and the latter required 29 KW.-hours per train mile, as against 188 lb. of coal under steam conditions.

Turning to the freight service, the electrical results show to even greater advantage. Measured in 1,000 ton-mile units, 282,862 were moved under steam, and 364,087 under electric operation, requiring 176,937 steam train-miles, plus 56,363 helper engine-miles, as compared with 186,010 electric train miles and 20,157 electric helper miles. For this work 43 steam and 15 electric locomotives were used, which, allowing for the additional electric ton-miles, shows that three and three-quarter times as many steam locomotives were required to handle

the same ton-mileage, though this does no represent the whole of the difference, as more electric locomotives were available than would be normally used.

In 1,000 ton-miles per engine, steam averaged 6,745, as against 24,260 under electric traction. The total time under steam conditions was 17,825 hours, as against only 14,535 hours for electrical working, representing 3.78 mins. for steam, and 2.39 mins. for electrical working per 1,000 ton-miles, the latter requiring 39.4 KW.-hours and the former 276 lb. of coal. The steam data includes no mileage for light-engine working, while the electric working presumably allows for energy returned to the system during regenerative working, which is a feature of this line, and during one month amounted to 11½ per cent. of the total power consumed at the motors, as measured at the locomotives.

The Norfolk & Western electrification was designed for a special purpose, *i.e.*, to reduce the time taken and to obtain greater efficiency in handling the heavy eastbound mineral traffic up the Elkhorn grade and through the Elkhorn tunnel, which is single tracked. Electrical working has increased the average speed from seven to 14 miles an hour, and the average engine-miles per day from 60 to 100.

The maximum east-bound tonnage of 51,226 under steam conditions has increased to 59,543 under electrical working, but only nine electric locomotives were required to deal with the maximum day's traffic, as compared with 43 steam locomotives. In 1914, 132,618 loaded eastbound cars required 93,625 engine-hours, but in 1916, 165,680 cars were dealt with electrically in 44,112 engine-hours. The through freight and passenger trains are still worked by steam, but are helped by electric locomotives; the latter have, with reduced operating costs, doubled the capacity of the line.

Both these instances of electrical working may be classed, by those who feel so disposed, as special applications, in which the conditions were favourable to electric traction and unfavourable to steam operation, though it seems probable that the results will bear a wider application, in view of the tendency for railway conditions to become more and more difficult for steam operation, and ever more favourable to electrical working. The paying limits of railway electrification are not easily defined in practice, if battery traction is taken into consideration as an adjunct. In this country the limits of suburban electrification schemes have shown greater expansion in recent times—the South-Western being an example, while the London-Brighton, and London-Southend electrification proposals — unfortunately in abeyance at the moment—the Manchester suburban schemes, and the North-Eastern mineral railway electrification, all indicate that even our conservative railway directorates are showing a widening interest in the extended application of electric traction, under conditions which a few years ago would have been regarded in railway circles as impracticable.

An important point is that nearly all the foregoing projects originated before the war, when the cost of fuel and labour were relatively much more favourable than they are now, or will be after the war, *i.e.*, the conditions are becoming such that the paying limits of electrification will be greatly extended, and this will be even more the case when cheap electric power becomes available in large quantities in industrial areas—which are also heavy railway traffic centres—as an outcome of the proposed reorganisation of our electric supply industry. Under the probable conditions of the near future British main-line operation by electric traction may become an economic necessity—though we are well aware that the cherished tradition of the past will not be overcome without a struggle.

Trade Commissioners.

Some time ago it was announced that the Government intended to appoint 12 additional Trade Commissioners. We have so often expressed our opinion concerning the usefulness of the services rendered by the four Commissioners who have acted in this capacity for some years past that we need not repeat it now. What we, as plain men, cannot understand is why, when a decision has been made it cannot be acted upon without a prolonged period of waiting. These additional Trade Commissioners have been asked for by the business world for many years past, and its recommendation has been authoritatively endorsed by committees that have reported upon the after-the-war situation. Since the Government made up its mind to act, a great deal of time and attention have been devoted to the schemes for a reorganisation of our Commercial Intelligence Services (Board of Trade and Foreign Office), and, according to the daily Press, such reorganisation scheme, bringing trade intelligence matters under unified control, has been approved by the Cabinet. It may be that it is because headway has been made at last in that connection that the Civil Service Commission has been authorised to invite applicants for the positions of Trade Commissioners to lodge particulars of their qualifications. They have to be, according to the announcement, men possessing a good knowledge of import and export trade, who have had commercial experience at home and abroad, and who should be under 50 years of age. In our own opinion, the more they know of engineering and electrical affairs the better, for we look for far-reaching and beneficial effects to ensue for our particular industries from the efforts of the 16 Trade Commissioners of the British Empire during the years following the war. The selection of the most likely men will be made by the Selection Committee of the Civil Service Commissioners, and that Committee's recommendation will be passed on to the President of the Board of Trade after the chosen applicants have been interviewed. We sincerely hope that in every case the choice will be wisely made, and on essential merit, and that there will not be another long period of waiting. The Commissioners should be ready to take up their work straightaway.

The Ignition Magneto Industry in France.

Just as was the case in Great Britain, so also in France, prior to the war, the automobile industry was mainly dependent on the German Bosch Co. for its supply of ignition magnetos. The situation was so dealt with that quite a large number of magneto manufacturing concerns have sprung into existence there, with the object of not only freeing the business from the German monopoly, but also of rendering the country self-supplying as regards magnetos for ignition purposes. One of the principal makers is the S.E.V. Co., in which about 75 per cent. of French motor-car manufacturers are financially interested. This concern took over the Bosch establishment in Paris early in the war, and ran it until its own magneto factory, which is now ten times as large as the French Bosch plant, had got into working condition. Other French concerns now making magnetos are Messrs. Grouvelle and Arquembourg, the Salmson Aviation Motor Co., the Compagnie Générale des Magnetos, the Lavalette-Eisemann Co., the Gibaud Co., the Nilmelior Co., and about half-a-dozen other small concerns. It is understood, too, that the De Dion Bouton Co., makers of the motor-cars of that name, are establishing a plant for the production of magnetos.

BALANCER USED FOR TESTING PURPOSES.

For some years the balancer, of which the diagram of connections is shown, has been in use for the testing of motors and dynamos. With the use of this machine on a supply of 500 volts pressure, any direct-current motor from 50 volts to 500 volts may be tested up to a limited horse power. One of the chief features about it is that the pressure can be regulated with ease to suit any motor. This balancer is comprised of three six-pole shunt-wound machines, with lap-wound armatures, which are all direct-coupled.

The three armatures shown are connected in series with each other across the 500-volt supply. The shunt windings of all three machines are connected in parallel across 500 volts, and, as will be observed from the diagram, they have

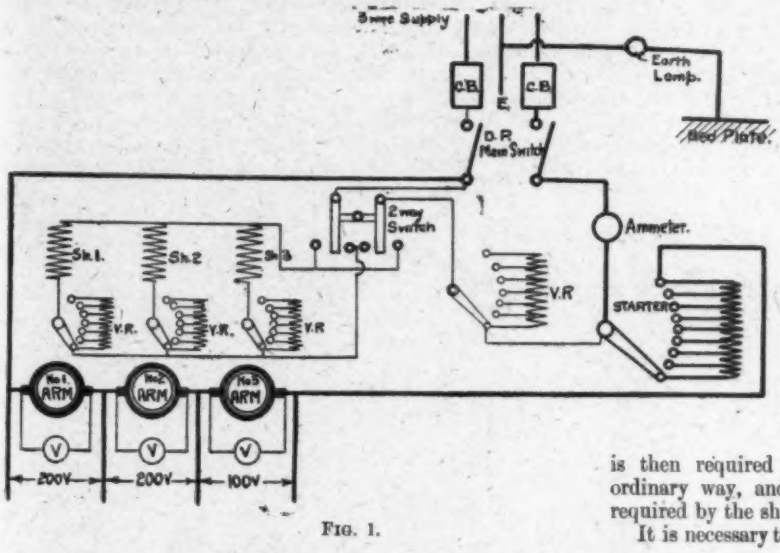


Fig. 1.

a variable resistance in circuit with each one. The pressure of 500 volts is divided up as shown in fig. 1, so that as the armatures are in series with each other, any alteration of shunt resistance alters the voltage on all three armatures; and when the volts are reduced on one armature, the volts subtracted are added to the volts on the other two armatures. If the two armatures normally at 200 volts each were reduced to 180 volts each, the armature normally at 100 volts would then be increased to 140 volts.

It is convenient to have a voltmeter connected with each armature, as shown, when the effect of using the variable shunt resistances can be seen.

The balancer itself is belted up to the larger sized machines, and so it is necessary to reverse it; the two-way switch is employed for this purpose. This switch is only operated when the double-pole switch is out, and it is possible to arrange a device to prevent breaking the shunt circuit when the current is on.

The other variable resistance shown in the diagram is for the purpose of increasing or decreasing the speed of the balancer, and so increasing or decreasing the load of any motor which may be tested by being belted to the balancer. The four cables from the armatures are connected to switchboards in parallel with each other, which are fixed in convenient positions near the test plate.

In testing the smaller sizes of machines, the load is supplied by other permanent shunt-wound machines connected as motors from the switchboard as shown in fig. 2, and when any motor is running with full load, the current generated is fed back to the balancer. This permanent shunt machine is fitted with a shunt-reversing switch for changing the direction of rotation, and also a variable shunt resistance for adjusting the load of the motor which is being tested.

It is also convenient to have a four-way switch and voltmeter on one branch switchboard to observe the voltage between different main terminals. The outside voltage would be 500 volts, and armatures 200, 200, and 100 when normal. In an actual test of three motors, the largest being belted to the balancer, and the two others on to the permanent machines, the writer took the readings of the watts supplied and the watts used on the motors. The motor readings were :—

No. 1, 220 volts,	180	amperes	=	39,600 watts.
No. 2, 220	,, 55	,,	=	12,100 ,,
No. 3, 110	,, 53	,,	=	5,830 ,,
Total watts used ...			...	57,530

The ammeter in circuit with the balancer as shown in fig. 1 read 49 amperes when the motors were using the total watts stated, which gives us $500 \times 49 = 24{,}500$ watts supplied, and 33,030 watts saved. It is, of course, more economical to test as many motors as possible at one time, as the balancer takes 9,000 watts when running without load, and a load is required to justify the use of it.

When starting to test a motor, as in fig. 2, it is best to start No. 1 motor first, and in the case of testing a series motor, it is necessary to start up this motor first, as a series motor requires a load to start in order to prevent it racing away. Adjust the speed on this machine by means of the shunt resistance to give the speed required by motor No. 2. All that is then required is to start motor No. 2 up in the ordinary way, and afterwards adjust the load to what is required by the shunt resistance of motor No. 1.

It is necessary to have the shunt resistance of motor No. 1

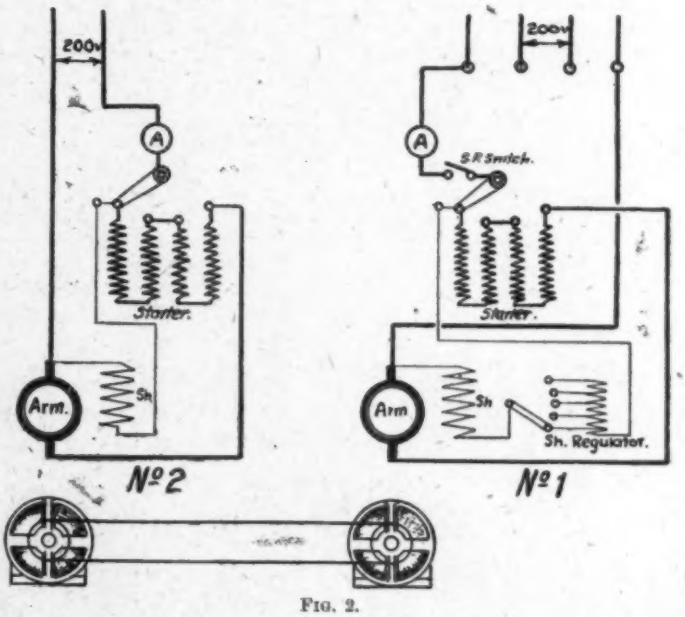


Fig. 2.

in small steps, and suitable for varying the load very slightly.—A. K.

Copper Shell Bands.—Mr. Sherard Cowper-Coles informs us that a plant of considerable size is being erected in the South of England for making shell bands by the Cowper-Coles centrifugal copper process, in which the Government is interested.

NOTES ON ALTERNATING-CURRENT TRACTION MOTORS.

Numerous proposals have been put forward in connection with the development of single-phase commutator motors, suitable for the propulsion of electric trains. Prior to the war a great deal of experimental work was being undertaken, especially on the Midi Railway in France, and it is a matter of regret that this important work has been interrupted.

The single-phase system has, of course, made the greatest headway on the Continent of Europe and in America. What is used largely on the American lines is the series compensated motor; that is, a motor having the armature, the main field winding, and compensating winding connected in series. As the compensating winding carries current equal and opposite to the armature current, the cross magnetisation is neutralised over the entire pole face, and the compensating winding not only counteracts field distortion but also improves the power factor, for any field in an alternating-current machine must of necessity increase the wattless current. The main field that produces the torque and a commutating field are, of course, necessary, but the armature field is harmful, and should be compensated. Motors with a local commutating pole-winding only are satisfactory on direct-current circuits, but not on alternating-current circuits. What is wanted and what is provided in the latter case is a distributed compensating winding embracing the greater part of the armature.

The main advantage of this type of motor, having the main field and compensating windings in series with the armature, is that the machine will work with direct current. Of course, in some cases the compensating winding is short-circuited upon itself when the compensating current is produced inductively. Experiments indicate that the results obtained with the two methods of exciting the compensating windings differ inappreciably, provided the motor always works with alternating current. But when motors have to work with direct current as well as alternating current, it is better to have all the windings in series, for the compensating winding then remains active under both conditions, and will always prevent field distortion and improve commutation. Motors with the compensating winding in series with the armature are used in this country on the electrified line of the Midland Railway and on American single-phase railways.

In addition to the distributed compensating winding, there may be local commutating pole windings, but so far the use of motors built on these lines has been confined mainly to Continental railways usually working at periodicities in the neighbourhood of 15 cycles per second. The Lötschberg locomotives, for instance, are fitted with motors of this kind. The interpole winding may be energised from the secondary of a series transformer having its primary connected in series with one of the motor leads, when the strength of the current passing round the interpoles varies in proportion to the load. The axes of the main and compensating windings are at half the polar distance from one another, and the third, or commutating, winding is arranged inside the compensating winding and between two adjacent slots, so that the commutating turns only embrace a single tooth.

Certain types of so-called repulsion motors have also been used successfully on single-phase railways. The compensated repulsion motor of the Latour, Winter Eichberg type has come into considerable use for light railway work, for which it seems well adapted. The circuits of this machine are similar in most respects to those of the plain series motor, but the motor possesses an additional set of brushes short-circuited upon themselves, and in mechanical line with the windings of the stator. In distinction to the performance of the compensated series motor, in which the effect of speed is to increase the apparent resistance of the armature, which possesses negligible reactance, the armature of the compensated repulsion motor possess at starting the major portion of the apparent reactance of the motor, and the effect of increased speed is to decrease such apparent reactance continually. The motor has the advantage of working at practically unity power factor, due to the property of commutator motors with short-circuited brushes having no inductance at synchronous speed and negative inductance above that speed. When employed for railway work, the speed control is obtained by a series variable-ratio transformer, the primary of which is in series with the main field circuit, and the secondary is connected to the main brushes. There need not, therefore, be any direct connection between the stator and armature, and the variable-ratio transformer permits of obtaining a number of speed-load curves. The motors operating on the electrified lines of the Brighton Railway are, as is well known, of the compensated repulsion type.

Another type of single-phase commutator motor that has proved suitable for traction purposes is the Déri motor, as fitted to the motor-coaches running on the Martigny-Orsières Railway in Switzerland. The advantage of this motor is that speed control may be obtained by shifting the brushes, with the result that all contactors and other voltage-regulating arrangements are eliminated. The stator winding is entirely independent of the armature, and current can, consequently, be supplied to these motors at pressures appreciably higher than those permissible with series compensated motors. On the commutator are two sets of brushes—one fixed and the other movable, and the fixed and movable brushes are connected together by means of flexible cables. To bring the armature to rest the movable brushes are shifted so as to be in line with the axis of the stator; but by turning this set of brushes out of this position, the armature is made to revolve. When the movable brushes shift away from the fixed brushes, the flexible cable maintains electrical connection between them, and when the brushes are brought together there is, of course, no difference of potential across the brushes. Thus no current flows in the armature. Under these circumstances, the only current taken by the motor is the magnetising current, for the conditions correspond to those which prevail when a transformer is connected to the mains without load on the secondary. But as soon as the movable brushes are shifted away from the fixed brushes, current flows in the armature winding and a torque is developed. The Déri motors employed on the Martigny-Orsières Railway are four-pole machines, and are designed for a pressure of 500 volts and a periodicity of 15 cycles per second.

The experiments made on the Midi Railway are very interesting, because every traction motor of importance has been tried. One of the conclusions arrived at was that ordinary repulsion motors are most satisfactory when running at synchronous speeds, a fact that is now pretty generally recognised. It happens that the transformer cross field in in these motors is of such phase as to induce in the short-circuited armature coil by rotation a pressure which practically counteracts the harmful sparking voltage, and this cross field is of approximately the correct strength for compensating the sparking voltage when the speed attains the synchronous value. This simple fact, it seems, has settled the future of repulsion motors, for such motors are best adapted for operating near the synchronous speed. At speeds above synchronism the transverse field increases in strength, the commutation becomes unsatisfactory, and the iron losses increase.

On some single-phase motors it is customary to impress a certain voltage on the armature and main field winding, and another voltage on the compensating winding, and these motors are sometimes called series repulsion motors. The two voltages may be taken from different parts of the main transformer or from the same part of it. Imagine an armature connected in series with a main field winding and a compensating winding, and also connected to the secondary of a transformer like an ordinary series compensated motor, then if a tapping be taken from the transformer and be connected to the junction between the main field and compensating winding, we have what is sometimes called the series repulsion or doubly-fed motor. The effect of the additional transformer connection is that at the higher speeds the commutation is improved. The so-called series repulsion connection is therefore adopted as a running connection—that is, when the motor is running above its synchronous speed.

The locomotive built by the French Thomson-Houston Co. for the Midi Railway is fitted with series repulsion

motors. When starting, the brushes are short-circuited, and current is supplied to the stator terminals, so that it passes through the main field and compensating winding. After the motor has attained synchronous speed, however, the short circuit across the brushes is removed, and the armature is connected in series with the stator windings. At the same time, an additional voltage is impressed upon the compensating winding, thus producing a local strengthening of the field, which assists commutation. This voltage, like the main voltage, applied to the terminals of the motor, is taken from the main transformer. The motors on this locomotive have 20 poles; consequently, at the working periodicity of 16⅔ cycles, the synchronous speed is practically 100 revolutions per minute, and this corresponds to a travelling speed of 25 km. per hour. When the armatures are connected in series with the field windings, however, the maximum speed of the locomotive is 78 km. per hour, or about three times the speed attained when the motors are running at synchronous speed.

The locomotive built for the Midi Railway by the Ateliers de Constructions Electriques du Nord et de l'Est is also fitted with motors that are started as repulsion motors, but the field windings are afterwards connected in series with the armature. At the low speed the repulsion connection gives results in every way satisfactory. There are two commutation or compensating windings, both in the same slots, and for series working they are connected in parallel. They each have a different number of turns and different cross sections, and are, of course, displaced 90 electrical degrees from the main field which provides the torque. When the motors run as repulsion motors the brushes are short-circuited and the current is fed into the machine through the main stator and compensating winding. Under these conditions, however, only one of the commutation windings is active.

The French Westinghouse Co. also built a locomotive for trial on the Midi Railway, and the motors fitted to it are ordinary series compensated motors, which transmit their power to the driving wheels through gearing, whilst the locomotive built by Brown-Boveri is fitted with Déri motors controlled by shifting the brushes. There are, of course, other kinds of single-phase commutator motors besides those which have been mentioned—such as reverse doubly "fed motors." Innumerable schemes of connections have, in fact, been devised for these machines, but it is doubtful if many of them are of any real practical value.

The motors referred to, however, have all proved themselves suitable for electric traction purposes, and some have been in service for a considerable time.

MERCURY RECTIFIERS FOR LARGE OUTPUTS.

Except in matters of detail, there has been no important change in the construction of large mercury rectifiers during the past five or six years, but there are now a number of installations which have been in satisfactory service for some years, and the popularity of large mercury rectifiers will undoubtedly continue to increase, for they offer the nearest possible approach to the ideal "static converter." Rectifiers of this type have been in use for years without requiring any renewals or repairs, and with only intermittent use of a vacuum pump. The principal features of a modern "ironclad" mercury rectifier may be gathered from fig. 1.* The main working space A and the condensing chamber B are enclosed by steel cylinders with strong steel end plates C and D. The bottom plate carries the insulated mercury cathode K, and the main anodes E pass through the ring D. Six or 12 anodes are used (for 50, 100, or 200 amperes each), and they are mounted concentrically with the cathode on as large a diameter as possible. The condensing chamber is welded to the anode ring D, and the latter makes a gas-tight but removable joint with the main chamber. The top plate of the condensing chamber carries the ignition solenoid, vacuum connection (V), and eye-bolt. The main and condensing chambers are provided with water jackets S T, which lead into annular spaces Q R in the anode ring. These spaces are connected by radial cooling channels, hence the leading-in equipment is kept cool. Both the anodes and the cathode are cooled (by F and L respectively); and O P represent the fall and rise pipes for the water circulation. A compound packing of asbestos and mercury is found most effective in preventing leakage of air through the anode bushes, &c.

A mercury trough U is mounted below the condensing chamber, and arcs emanating from the anodes are received within a funnel-shaped collector, the bottom opening of which is submerged in the mercury cathode. Reaching down to the centre of the cathode screen M is an iron striking anode H, which is operated by the solenoid J, so as to strike an arc on the mercury when commencing operation. One or two auxiliary exciting anodes G are fed with direct or alternating current, and ensure that the rectifier remains ready for immediate service, even though the load current be zero for some time (*e.g.*, in tramway service all the cars may be stopped simultaneously).

The two values of maximum cathode current at present adopted as standard by the Gleichrichter A.G.* are 250 and 500 amperes at 110 to 800 volts. It is remarkable that one and the same rectifier can be used for any voltage within the specified limit. Also, by using 6 or 12 anodes, the same type of rectifier can be used for full output from one, two or three-phase networks. When the output of a single rectifier is insufficient to meet the needs, several may be used in parallel and put into or out of commission like a single machine. Five 500-ampere rectifiers, for instance, yield 1,875 KW. at 750 volts.

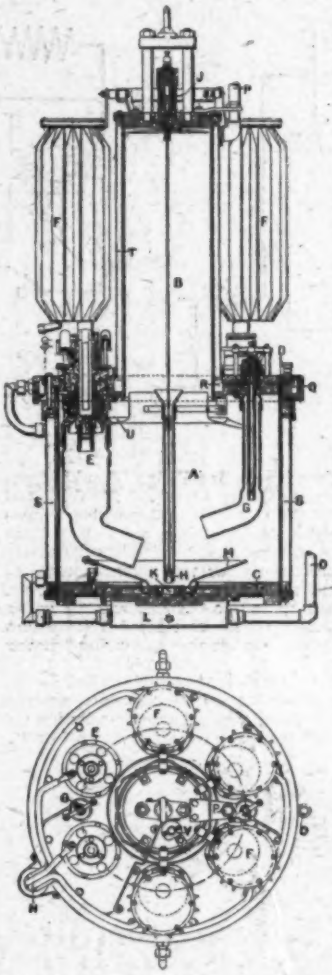


Fig. 1.

Connections.—In order to use several rectifiers in parallel, choke coils are connected in the anode branches. These may be arranged as current dividers (see fig. 2), which arrangement has the advantage of small energy consumption, but generally necessitates simultaneous working of the paralleled units. The choke coils in the circuit shown in fig. 3 have somewhat higher energy consumption and increased inductance, which is useful in damping out the current pulsations. Further, this method of parallel connection permits rectifiers to be switched on and off as desired. If each rectifier has a main transformer, the total voltage drop is sufficient to ensure satisfactory parallel working between rectifiers and/or other current-supplying equipment, without using choking coils. By connecting the transformer primary in star or delta, and using suitable choking coils, the total regulation of the rectifier may be made anything between 5 per cent. and 17 per cent., according to the characteristics of the D.C. source or sources with which it is to be paralleled. By using choking coils connected as in fig. 4, a practically constant D.C. pressure can be obtained from the rectifier at all loads from light to full, without the aid of governors or other special gear. For instance, in a certain case, the open-circuit D.C. pressure of 500 volts fell to 440 volts (*i.e.*, by 12 per cent.) at a current of 5 amperes or less, but thereafter remained practically constant up to a load exceeding 200 amperes.

Induction regulators or step transformers may be used for voltage regulation, and anything up to ± 5 per cent. variation in D.C. pressure may be obtained by tappings on the main transformer of the rectifier. A cheaper and more flexible system for use in charging accumulators consists of three choking coils with an adjustable core, which can be set by means of a hand wheel on the supporting spindle. The choker is connected between transformer and rectifier in the anode leads.

It is one of the advantages of the modern mercury rectifier that

* Reproduced from a recent issue of the *E.T.Z.*, whence these notes are derived.

* *i.e.*, the Rectifier Co., founded at Glarus in 1913 by the Brown-Boveri Co. (Switzerland), and Hartmann & Braun (Frankfort-on-Main). Hartmann has secured a compulsory licence to utilise the Cooper-Hewitt D.R.P. 157,642, so that there is now no difficulty in the way of constructing and marketing large mercury rectifiers. Their sale is said now to be turned over to Brown-Boveri & Co., Baden and Mannheim.

it needs practically no attendance or maintenance. Neither the mercury cathode nor the iron anodes decrease appreciably in weight during several years' working, and it is generally possible to work without an air pump after a few months' operation. The only attendance then required is to start the rectifier by closing a switch or press-button in the striking-solenoid circuit. Starting occupies only a few seconds, which contrasts favourably with the time required to start a rotary converter.

Until the rectifier has settled down to steady conditions, it is necessary to check its vacuum from time to time. This may be done by the aid of a McLeod vacuum meter, or the electrical device illustrated in fig. 5 may be employed. The principle of this device is obvious from the figure, and the vacuum meter may be placed at any distance from the rectifier.

Commercial Installations.—One of the first commercial installations of large mercury rectifiers was set to work about five years ago in J. F. Mack's iron foundry at Rodelheim (Frankfort-on-Main). The rectifier concerned delivers 80 KW. at 220 volts, and showed soon after its installation that it was possible to pass leading-in connections through a steel container, and to keep them insulated from the latter, whilst yet maintaining the necessary high vacuum (about 0·03 mm. mercury) without continuous use of a vacuum pump. This rectifier operates on single-phase supply, which is less favourable than polyphase current, and no better evidence of its satisfactory working could be desired than the fact that it is proposed to extend the equipment using similar rectifiers.

A 20-KW. mercury rectifier (110 to 165 volts), installed in the Hordt sub-station (Strassburg) in 1912, realises the good average efficiency of 85 per cent., and in this particular installation its noiseless operation is a valuable feature. More recently, a 53-KW., 230-volt, rectifier has been installed in the Dettweiler sub-station, this rectifier working alone or in parallel with a dynamo, according to the current required. Tests have shown that as little as 10 amperes rectified current may be taken without impairing the stability of working.

A battery-charging rectifier of 15-KW. output at 110 volts has been in use at the Charlottenburg Technische Hochschule since 1914 with satisfactory results; and the Maschinenfabrik Lanz (Mannheim) is putting in a 300-KW. installation of the latest type of mercury rectifier. Messrs. Brown, Boveri & Co. (Baden, Switz.) have had an interesting converting station (115 KW., 220 volts) in service for two years past for testing rectifiers on long-continued load. A 105-KW. D.C. motor with commutating poles forms the load. The motor drives an air compressor, and the load fluctuates between a quarter and full load, according to the demand for air. The mercury rectifiers tested are not affected adversely by this fluctuation, and comparison of the high-tension A.C. and the D.C. meter readings shows an average efficiency of 87 per cent., including all losses.

Since the autumn of 1915, two 150-KW., 600-volt mercury rectifiers have been used in the converting sub-station of the Limmattal tramway (Zurich-Dietikon). Formerly two motor-generators had to be kept running in order to cope with the peak loads, and the mean cost of current worked out at 0·59d. per car-mile. Now, however, either of the two mercury rectifiers can deal with the peak loads of 400 to 450 amperes, hence one rectifier is in reserve, and the mean cost of current has been reduced to 0·44d. per car-mile—*i.e.*, a saving of about 26 per cent. Successful tests were made in the way of operating the rectifiers in parallel with existing motor-generators and the overhead network of the tramways, the voltage drop of the motor-generators being about 14 per cent. at full load. Circumstances do not require these rectifiers to be operated regularly in parallel with the motor-generators. A certain amount of disturbance was at first occasioned in telephone circuits, but since correcting defective insulation, speech has been as clear as when the tramways were operated with pure direct current. The oscillograms in fig. 6 show the current and pressure pulsations on the D.C. side of the rectifier. The comparative smallness of the pulsations is due to three-phase supply being used and to the high inductance of the series traction motors. The latter have not run appreciably warmer since the introduction of the rectifiers. The rectifier cylinders employed are each capable of 250 amperes continuous output, but the load conditions require an average output of only 90 amperes, with momentary overloads up to 450 amperes. Each rectifier is cooled by water circulating through an elevated cooling tank of corrugated iron, and, apart from adding water from time to time, the cooling system requires no special attention. After some month's operation, the air pump can be put permanently out of service. Alternating current excitation is provided to ensure that the rectifiers keep in commission, even should the current consumption fall temporarily to zero.

In the Norstadt sub-station of the Pforzheim municipal electricity station, the primary supply at 5,120 volts, 50 cycles, is converted to 110/220 volts D.C. (three-wire system). Four rectifiers, each yielding 75 KW. at 110 volts, or 150 KW. at 220 volts, are mounted side by side on a common plinth. The equipment feeds the town lighting and power network, and the rectifiers have to work sometimes in parallel with D.C. generators and with a rotary converter. Primary induction regulators in front of the rectifier transformers permit of ± 10 per cent. voltage regulation. The air pump and induction regulator are mounted inside the plinth. Water circulation is provided to cool the rectifier container; about 40 gallons of water per hour are required per 100 amperes useful current.

In the Plauensche Grund electricity station (Deuben-bei-Dresden) mercury rectifiers have been used since the beginning of 1916 to convert primary high-tension two-phase current to direct current at 530 volts for traction purposes. The two phase voltages may

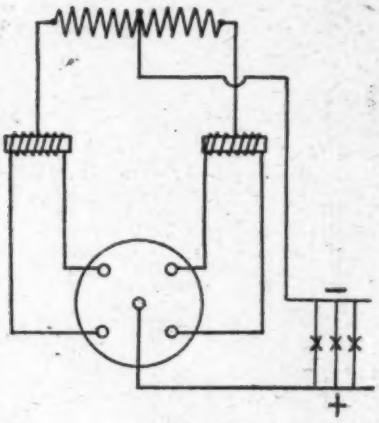


FIG. 2.

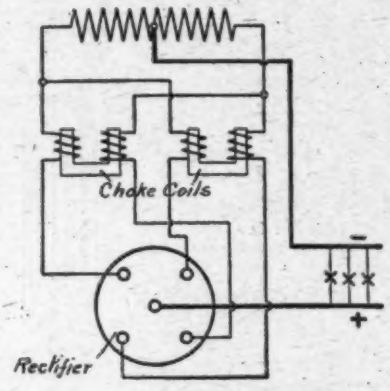


FIG. 3.

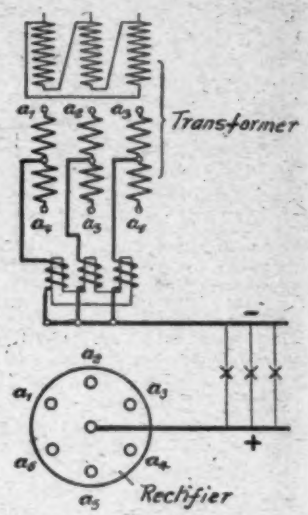


FIG. 4.

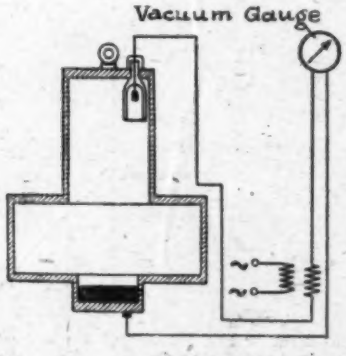


FIG. 5.

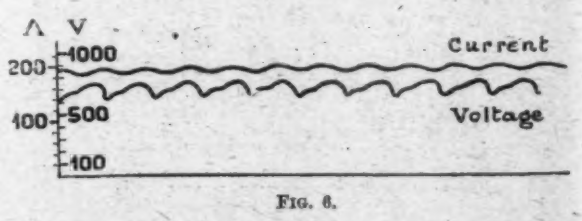


FIG. 6.

differ by as much as 10 per cent. in the course of a day, and, to compensate for this, a single-phase induction regulator may be connected in the leads of one phase, whilst for overall voltage control a two-phase main regulator may be connected in front of the rectifier. One or two of the rectifiers are generally in reserve. The rectifiers work alone or in parallel with the buffer battery or traction generators. The current output varies generally between 100 and 650 amperes, and the maximum voltage drop on the rectifier bus-bars is about 10 per cent. Another rectifier installation of equal power and voltage is in service at the Döhlen Steel Foundry (Dresden). In this case the current output varies from 600 to 800 amperes at 530 volts. This equipment was set to work early in 1916, and up to last October had delivered more than 1,000,000 units (D.C.). The D.C. and high-tension A.C. meter readings show an average overall efficiency exceeding 90 per cent. The rectifiers work in parallel with an 850-KW. Siemens-Schuckert turbine-dynamo and a 300-KW. Brown, Boveri set, except on Sundays, when the steam plant is shut down, and the rectifiers carry the whole D.C. load.

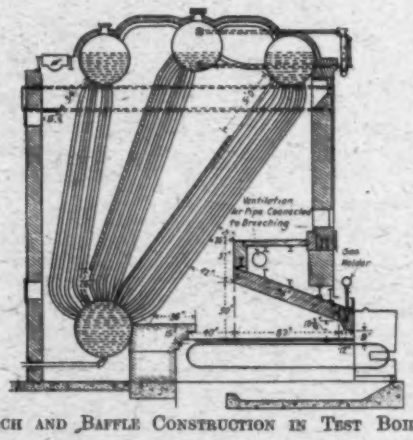
Two large installations which are in course of erection are a 500-KW., 400-volt, rectifier equipment for the Hirschberg electricity station, and a 600-KW., 800-volt, equipment for the Berggeist station.

The capacity and security of working of the mercury rectifier may soon be raised to the level attained in A.C. transformer practice. If it is found possible to deal with pressures up to or exceeding 5,000 volts, a particularly wide and valuable field of application is opened for rectifiers in electric railway practice. At such high pressures the loss in the rectifier would be negligible in comparison with the transformer losses and those in the line. The overall efficiency of the conversion would exceed 97 per cent. Possibly the rectifiers would be installed in sub-stations along the line, or they might be carried on the locomotives themselves, as has already been done experimentally in America. As regards producing very heavy currents for electrochemical purposes—say, 100,000 amperes or more, there is no reason to anticipate any insuperable difficulty, since rectifiers and groups of rectifiers can now be operated quite successfully in parallel.—S. M. POWELL.

COMBINED COAL AND COKE-OVEN GAS FIRING.

In view of the great interest which is being taken in fuel economy at the present time, and the efforts which will undoubtedly be made in the future to utilise all available sources of waste heat, particularly in connection with electrical generating stations, where in many cases it would not be possible to depend entirely on gas firing, the following particulars of the practice followed by the Toledo Railways & Light Co., U.S.A., at its Water Street Station, described in a recent issue of the *Electrical World* by O. W. Morgan, may be instructive:—

This company decided to adopt apparatus for the simultaneous burning of coal and coke-oven gas with a view to increasing boiler output to meet the growing load.



ARCH AND BAFFLE CONSTRUCTION IN TEST BOILER.

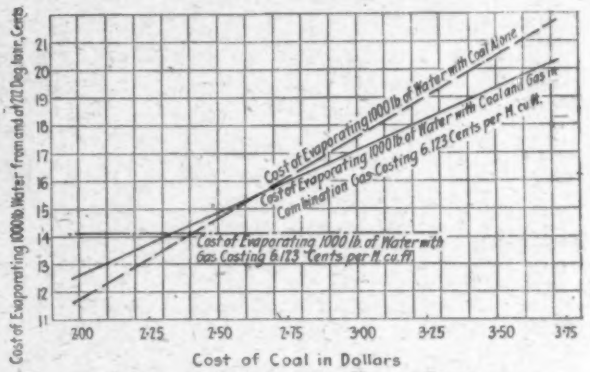
The conditions which made this solution of the problem possible were as follows:—The Toledo Furnace Co. installed a by-product coke oven, and contracted to sell the entire gas output to the Atlas Chemical Co. The latter concern, under its contract, is receiving about 9,000,000 cu. ft. of rich gas each 24 hours in excess of its needs. The chemical company needs only the lean gas for its operations. Therefore the rich gas, which has an average heating value of about 600 B.TH.U. per cubic foot, and which is the "first-run gas" from the ovens, is being delivered to the Toledo Railways & Light Co. through a 20-in. main, which is approximately four miles long.

Experiments were tried with several different methods of combining gas and coal firing, but it is now thought that burning coal and gas at the same time in the same furnace proves most economical, and a number of boilers have been equipped for this.

In the earlier experiments gas alone was fired, the flame being directed on to broken fire brick spread over the grate surface, in order to deflect it and prevent it from directly striking the tubes. This arrangement was successful up to 175 per cent. rating, but would not do for higher outputs. To increase the overload one boiler was equipped with a Dutch oven furnace, and 263 per cent. rating could be obtained, but the installation was inflexible.

Finally the gas was burned directly over the coal, a specially-shaped tile, with a 2½-in. gas inlet hole, being fitted in the front of the ignition arch, set so that the gas would be directed down against the coal. No air was admitted except that coming through the fuel bed.

A Stirling type boiler was employed, with 6,680 sq. ft. heating surface and 256 sq. ft. superheat surface; 200 lb. boiler pressure and 100 deg. F. of superheat. It was equipped with a Bailey boiler meter, and chain-grate stoker 10 ft. wide and 11 ft. 7 in. long, having 21.5 per cent. of air space through the links, and a speed of 4 in. to 9 in. per min.



CURVES OF COAL AND GAS FIRING COSTS.

The gas burner consists of a 1¼-in. pipe, with a cap drilled with seven 7/16-in. holes, inserted in the hole in the tile.

Five tests were made, some of them being check tests, on coal, coal and gas, and gas firing, and the results are tabulated herewith:—

COMPARISON OF BOILER PERFORMANCE BURNING COAL AND GAS SEPARATELY AND COMBINED.

—	Coal* alone.	Coal and gas.*	Gas† alone.
Pounds of coal used per hour	4,074	4,426·2	—
Pounds of equivalent coal used per hour	—	1,278·5	2,006
Equivalent pounds coal burned per square foot of grate surface	37·8	49·4	17·45
Cubic feet of gas burned per hour	—	29,163·0	47,785·00
Cubic feet of gas burned per pound of dry coal	—	6·61	—
Per cent. of ash and refuse to total coal	18·20	21·43	—
Per cent. of rating developed	163·25	213	88·7
Temperature of flue gases leaving boiler (in deg. F.)	640·1	689·5	516·6
Draught over fire	0·263	0·2875	0·0316
Draught in uptake under damper	0·220	0·220	0·0573
Efficiency of boiler grate and furnace in per cent.	61·4	61·6	72·95
Efficiency of boiler and furnace in per cent.	66·1	69·9	72·95
Pounds of combustible in ash	385·7	517·9	—
Per cent. combustible in ash to total coal burned by weight	8·8	11·7	—
Speed of chain in inches per minute	6·64	6·94	—
Cost to produce 1,000 lb. of steam from and at 212° F. (in cents)	11·65	12·58	14·10
HEAT BALANCE—per cent.:			
CO_2 in flue gas	10·43	12·37	6·75
O in flue gas	10·50	4·85	7·85
N in flue gas	79·07	82·78	85·40
Over ventilation	102·0	29·1	59·5
Heat absorbed by boiler	61·98	61·62	72·95
Loss by moisture in coal	0·34	0·30	—
Loss by burning hydrogen in coal and gas	4·13	6·16	12·58
Heat lost by dry chimney gases	16·87	13·72	9·59
Heat lost by unconsumed carbon in ash	9·50	9·76	—
Heat lost by apron water	0·72	0·59	0·15
Heat unaccounted and unaccounted-for losses	7·06	7·85	4·73

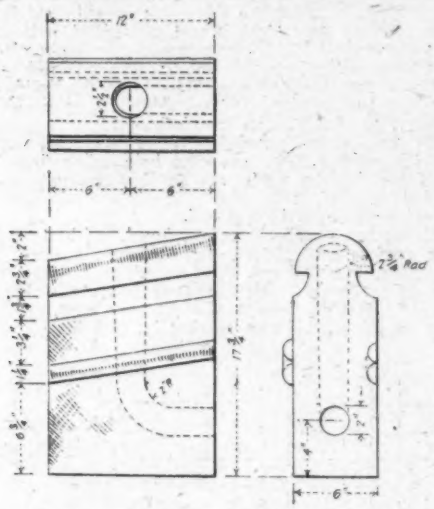
* Average of two tests. † Average of one test.

Practically equal amounts of coal were burnt with and without gas, so that the additional rating was due to the gas. The additional rating was 31 per cent. over that with coal alone.

The temperature of the flue gas leaving the boiler was 43 deg. F. higher with combined firing than with coal. Better results were obtained with a lower stack temperature with combined firing than with coal firing; the efficiency of boiler, furnace, and grate were a little higher in the former case, also the amount of combustible by weight in the ash was greater than with coal alone.

Owing to the low ultimate CO_2 (10.8 per cent.) obtained by complete combustion of coke-oven gas, the ultimate CO_2 from the combination firing was lower than for coal alone.

The results showed that the cost of evaporating 1,000 lb. of water from and at 212 deg. F. is 8 per cent. higher for



Gas-nozzle Tile used in Test Boiler.

combined firing, and 21 per cent. higher for gas firing than for coal alone. The company, however, obtained, with combined firing, 31 per cent. added capacity for the 8 per cent. increase in cost, and at 50 per cent. less investment than would have been required with coal.

IMPEDANCE OF STEEL RAILS.

In the design and operation of alternating-current traction systems in which rails are used as electrical conductors, accurate knowledge of rail impedance is of no little importance. In order to add to this knowledge, the research division of the electrical engineering department of the Massachusetts Institute of Technology has conducted a research to determine, by direct measurement, the impedance offered to alternating currents by standard steel rails of various shapes and sizes, and also to ascertain how this impedance varies with frequency and with current strength. Furthermore, it was desired to find, if possible, a simple theory by means of which the rail impedance can be calculated from physical data concerning the steel used in the rails and from the dimensions of the rails.

The rails employed in the tests were of standard length, 33 ft. (10·07 m.), and ranged in weight from 60 lb. to 100 lb. per yard

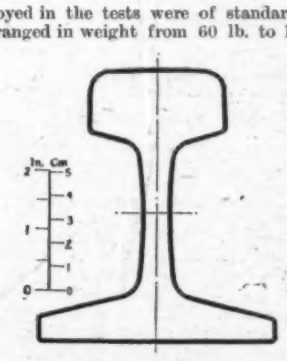


Fig. 1.—Equivalent Skin Depth of Alternating-current Penetration of Steel Rail.

(30 kg. to 50 kg. per m.). Frequencies of 25 and 60 cycles per second were used; a few tests were also made at 45 cycles per second. The rail current strengths employed varied from 10 amperes to 800 amperes R.M.S.

In order to obtain the results desired, it was necessary to measure, in addition to the direct-current resistance, the alternating-current voltage drop and current in the rail and the phase angle between them. The alternating-current potentiometer was found most satisfactory for these particular tests.

The ratio of alternating-current resistance to direct-current resistance, called "resistance ratio," was found in practically all cases tested to reach a maximum value within the limits of rail current from 10 amperes to 800 amperes R.M.S. This maximum value of resistance ratio, at 25 cycles per second, was observed to vary between 5·3 and 10·1 for 10 track rails and between 10·9 and 13·4 for two contact rails. For most rails the lowest observed value of resistance ratio of a sample was from 40 to 60 per cent. lower than the maximum value for that sample at constant frequency, the reason for this large range of resistance ratio being the variation in the permeability of the steel at the various flux densities corresponding to different strengths of rail current.

The equivalent skin depth of alternating-current penetration—defined as the thickness of uniform rail skin which would offer the same resistance to a direct current as the entire section offers to an alternating current—was found, by calculation from the experimental results, to be 1·5 mm. ($\frac{1}{16}$ in.) for a typical rail at 25·5 cycles per second and at maximum permeability. (See fig. 1.)

The maximum observed skin-effect resistance ratio was found to vary substantially as the square root of the impressed frequency between the limits of 25 and 60 cycles per second.

The self-inductance of the rails was also found to increase, with increasing current, and to reach and pass a maximum value, for current strengths up to 800 amperes, the total change of inductance varying, for the different rail samples, from 15 to 30 per cent. approximately.

The rail inductance is greater at 25 cycles per second than at 60 cycles per second, but the rail reactance at 60 cycles per second is greater than that at 25 cycles per second.

From the experiments conducted, it would seem that the skin-effect resistance ratio of a rail to a given alternating-current frequency and current strength can be approximately calculated by a simple formula involving measured values of direct-current conductivity and permeability of the steel, the area of cross-section of the rail, the rail perimeter, and an experimentally-determined factor to cover certain discrepancies. This factor appeared to be not more than 1·3 at the maximum skin-effect ratio.

The complete report on the investigation, entitled "Experimental Researches on the Skin Effect in Steel Rails," by A. E. Kennelly, F. H. Achard, and A. S. Dana, is available as Research Bulletin No. 12 of the Electrical Engineering Department, Research Division of the Massachusetts Institute of Technology.—*Electrical World.*

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Teagle Ignition Magneto.

It is not only in this country that increasing attention is being devoted to the manufacture of high-tension magnetos for automobile ignition purposes, in order to make sure that enemy-produced machines shall never again dominate the market as they did in pre-war days. It is the same in the United States, where not only are the older magneto makers extending their factories, but several new magnetos have recently made their appearance. Among the latter is the Teagle, made by the Teagle Co., of

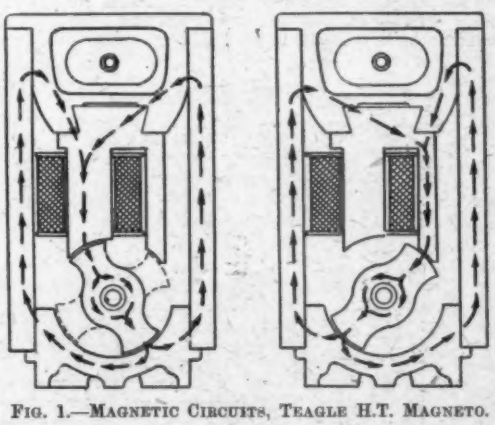


Fig. 1.—Magnetic Circuits, Teagle H.T. Magneto.

Cleveland, Ohio, and of which we are this week able to give some particulars.

The new machine, which has been specially designed for use in connection with the engines of industrial motor vehicles and tractors, is of the inductor type, in which the coils in which the current is induced are stationary, the only rotating parts being the distributor arms and gears, and the shaft with a laminated rotary armature attached to it. There are no moving wires, slip rings, or brushes, with the exception, of course, of the collector brushes in the distributor. The quality of metal used in magneto manufacture has much to do with the efficiency of any given design, on the one hand, while, on the other, the technical difficulties encountered in connection with the working up of the material renders simplicity of design a fundamental of magneto quality and efficiency. It is claimed that this is a special feature of the Teagle magneto, as, instead of being of the usual horseshoe pattern, the permanent magnets are of the bar type, which can be easily ground with the requisite accuracy, and also heat-treated; the magnets are

securely clamped to top and bottom yokes of grey iron, and of liberal section. The field is formed, bored, and ground as a single piece to ensure true alignment of the bearings and pole faces ; and the stationary coil, condenser, and laminated pole-piece are likewise assembled as a unit, and mounted integrally with the top. The bottom yoke forms a pole-piece extending nearly half way round the rotor tunnel, while the top yoke has two poles, one carrying the windings or coils, and the other serving as a magnetic by-pass.

The magnetic circuit is shown diagrammatically in fig. 1 ; in one case, the rotor-pole is shown opposite the pole of a top yoke, which carries the coils, and, with the rotor in this position, the maximum flux passes through the coils. In the other case, the rotor is shown opposite the end of the magnetic by-pass, and in this position all the magnetic flux passes through the by-pass, and none through the coils. As the rotor has two poles, the flux through the coils passes through a maximum, and a minimum twice every revolution of the rotor. Another feature of the machine is the uniflow direction of the current—that is to say, the same electrode is always the positive, this being due to the special characteristics of the magnetic flux. The further result of this uniflow direction is that the current goes to build up, instead of to weaken, the strength of the magnets. Again, there is no break in the magnetic flux, with its resulting electrical wear and tear, as the flux starts from the magnets, flows up on each side, through the head casting, down through the laminated pole-piece, then through the stationary coil, thence through the vertical (flux) distributor to the base, and, finally, to the lower ends of the magnets. Now, as the distributor to the sparking plugs revolves, it leaves the segment of the laminated pole-piece, extending through the coil, and comes into proximity with the by-pass, through which the flux passes, instead of through the coil, its path being otherwise the same as before.

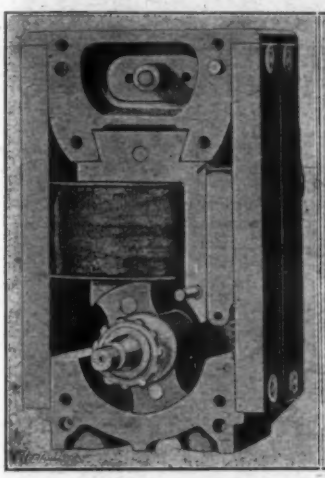


Fig. 2.—Magneto with End Plate Removed.

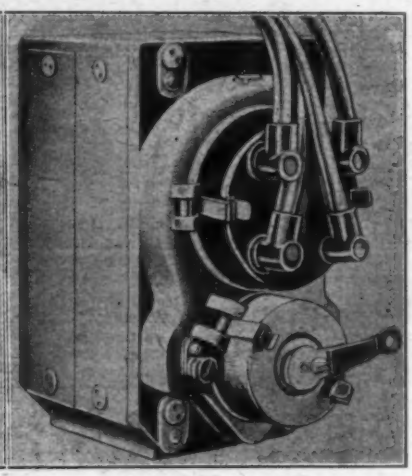


Fig. 3.—Teagle Magneto.

The plain bar shape of the magnets, of course, facilitates the calculation of the ratio of the cross-section to length in order to obtain the best efficiency, a result that is further assisted by the uniflow of the current owing to the re-magnetising instead of de-magnetising action therof. The coils, too, are so proportioned as to minimise all tendency to surging and high-frequency oscillation ; and being stationary, there should be no mechanical strains set up by centrifugal action.

The circuit-breaker and the distributor, which are the only parts requiring occasional attention, are both readily accessible for cleaning or adjustment. The electrical connections are protected by insulating material, and excess voltage strains are obviated by an enclosed safety gap, which is visible and readily accessible. The metal of the distributor gears is, as usual, of steel and bronze, while the bearings for the gears are cast integrally with the front die casting. Two sparks are produced per revolution, the sparks having high-initial voltage, and of sufficient duration to ensure complete combustion.

The Teagle magneto is made in two types, in both of which the simplicity of design and construction is claimed not only to result in mechanical and electrical advantages, but to permit comparatively cheap cost of manufacture, notwithstanding the high quality of the material and workmanship. Both types of machine are claimed to be proof against the action of water, dust, and oil, and, as they can be fitted with impulse starters, the hard work of quickly starting up high-powered engines is eliminated.

An Optical Pyrometer.

The eye is very sensitive in comparing the brightness of two surfaces when one is superposed upon the other, and after having arranged to have light from a hot body and light from a standard of comparison viewed in this relation, they can be made equal by varying the intensity of the standard of comparison.

The Leeds & Northrup Co., of Philadelphia, working under the fundamental Morse patents, has lately developed this type of optical pyrometer. The instrument is suitable for measuring from dull red (about 1,100° F.) up to the highest known temperature.

The manner in which the luminous radiation from the hot body is balanced against that from a standardised source will be understood by reference to fig. 4. L is a lens by which rays from the hot body are brought to a focus in the plane F, where there is located a tungsten lamp filament. By means of the eyepiece E, the observer views the incandescent filament, which appears to lie upon the image. By means of a rheostat in a case slung about the neck, the case also containing a storage battery and milliammeter, the current through the lamp is adjusted until the brightness of the filament is just equal to the brightness of the image produced by the lens, so that the filament becomes indistinguishable upon the background formed by the hot object. The observer then notes the reading of the milliammeter, which may be provided with a special scale to read in degrees of temperature, or the temperature corresponding to the current may be read from a calibration curve.

The adjustment is made with great accuracy and certainty, as the effect of radiation upon the eye varies some 20 times faster than does the temperature at 1,300° F., and some 14 times faster at 3,400° F.

At high temperatures the light emitted by both the hot body and the filament would become dazzling and comparison would be difficult. For this reason a red glass is placed in the eyepiece at R, which has the further advantage that light of only one colour then reaches the eye, and no difficulty is introduced by lack of colour identity between the light emitted by the hot body and that emitted by the filament. The intensity of light radiation of any one colour increases progressively in a definite manner as the temperature of the radiating body rises, and nothing is therefore lost by eliminating all other light from the comparison. As only brightness, not colour, of light is matched, inability to distinguish colours and colour-blindness does not interfere with the use of the instrument. In fact, in the region of temperatures used for hardening steel, for example, different observers using this instrument are said to agree in their readings within 6° Fahrenheit.

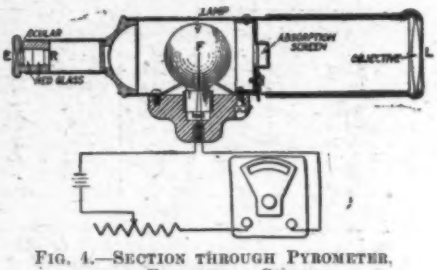


Fig. 4.—Section through Pyrometer, also Electrical Circuit.

The brightness of the image of the hot body produced by the lens L is almost constant, irrespective of the distance from the hot body, although the size of the image varies with the distance. Since it is the brightness of the image and not the total radiation received through the lens that is measured, it is possible to measure the temperature of a small body or of a body at a distance equally as well as that of a large body or one near at hand.

In observing bodies at very high temperatures, the light received through the lens would be too blinding for direct observation, even through the red glass of the eyepiece, and the intensity of the image might also become greater than that at which it is practicable to burn the tungsten filament, so that a balance would become impossible. Therefore a screen is used, placed between the lens and the image so that it reduces the light from the hot body, but not that from the filament. The screen can be thrown into or out of the field of view by means of a milled disk projecting through an opening in the tube of the instrument. With the absorbing screen in use, a different milliammeter scale or calibration curve is required ; but as the range of the instrument without the absorbing screen overlaps by many hundred degrees the range with the absorbing screen, the accuracy of the two scales can always be checked by observing a hot body whose temperature lies within this range.

The constancy of the lamp has been investigated exhaustively by the United States Bureau of Standards and by the National Electric Light Association, also in the laboratory of the Leeds and Northrup Co., and it has been found that after a tungsten filament is thoroughly aged—that is, burned for some time at a temperature higher than that to which it will be subjected in service—no sensible variation occurs. The instrument is so designed that one lamp can quickly be replaced by another, and by keeping two lamps, their correctness can be insured by checking one against the other.

The instrument itself is handy and portable, weighing but a few ounces, and can be sighted as easily as an opera glass. The case containing the battery, rheostat, and milliammeter weighs about 10 lb.—*Power*.

Engineering Wages.—The executive of the Federation of Engineering and Shipbuilding Trades has placed on record a protest as to the inadequacy of the 3s. award which came into operation on August 1st.

ELECTRIC POWER FOR STEEL MILLS.

The following has been taken from a report of the Central Station Power Committee of the American Association of Iron and Steel Electrical Engineers.

The power requirements in steel mills generally range from 1,000 to 10,000 KW. or more. A fair average is about 4,000 KW. The load is characterised by large peaks. Where alternating current is used the power factor will vary from about 65 to 80 per cent. Large generating capacity is required to provide service of the proper regulation. Table I has been compiled from data obtained from a number of steel mills, and shows the generating capacity actually installed, together with the connected load in motors and lighting.

In all large modern central stations the power is generated and transmitted as alternating current at a high voltage. At the receiving end of the transmission line this power must be transformed down to at least two, and generally three, lower voltages—namely, 6,600 or 2,200, 440 or 220, and 110; and where direct current is used it has to be converted from alternating to direct current. The 6,600-volt or 2,200-volt current is used for driving the motors of the motor-generator sets, also the large motors driving the mills and some of the larger auxiliaries (say from 100 H.P. up for the 6,600-volt and 50 H.P. up for the 2,200-volt) for driving pumps, fans, blowers, &c., in situations where these voltages can be used without danger.

TABLE I.—Instances of Generating Capacity Actually Installed.

Generating capacity.			Connected load.				Energy.
Total KW.	No. of units.	Largest unit.	Motors. No.	Motors. Total H.P.	Light. KW.	Total. KW.	KW.-hours per year.
10,400	8	3,500	950	49,790	750	44,565	27,072,000
1,650	3	550	202	6,870	125	6,171	4,225,000
9,500	8	2,500	730	26,570	490	23,871	38,725,000
10,650	8	2,000	464	20,640	490	18,653	30,548,000
6,450	8	3,000	1,320	37,790	750	34,005	18,950,000
15,400	11	2,500	252	9,787	145	8,759	73,117,000
2,000	5	400	400	11,525	563	10,705	9,970,000
2,200	4	550	204	4,531	120	4,106	5,492,000
2,150	4	550	398	13,117	220	11,783	7,594,000

For the remaining auxiliaries the voltage is further reduced to 440 or 220 volts. Motors wound for these voltages have a wide range of application, covering almost all classes of service in the mill, especially where constant-speed characteristics are required. For lighting, 110 volts is generally used and transformed from either of the above voltages. In all of the above transformations a certain percentage of power is lost. In some contracts the purchaser pays for all transformation losses; in others, the power supply company pays for the losses of the first transformation and the purchaser for all others. A summary of the losses is given in Table II:—

TABLE II.—Percentage of Losses Incurred in Transformation, &c.

—	Original power delivered.	Losses from line to 6,600, or 2,200 volts.	Losses from H.T. transformer to feeder station.	Losses 6,600 or 2,200 volts to 440 volts.	Losses 440 volts to 110 volts.	Losses in conversion.	Net power delivered to feeder station bus-bars.
Mill drives	100	2·5	7·5	—	—	—	90·2
Alternating-current auxiliaries ..	100	2·5	7·5	2·5	—	—	87·9
Lighting	100	2·5	7·5	2·5	3	—	85·2
Rotary converters..	100	2·5	7·5	2·5	—	5	80·1
Motor-generator sets..	100	2·5	7·5	—	—	12	79·4

The 440 or 220-volt alternating-current auxiliaries can be used in almost all applications where direct-current power is used, the exceptions being where variable speed and dynamic braking are required. The direct-current motors are so much better adapted for this class of service that the disadvantage of greater conversion loss is more than compensated for by their flexibility and adaptability. Direct current will be used for cranes, tables, charging storage batteries, electrolytic work, and variable-speed motors especially those used for driving machine tools.

The alternating current is suitable for driving fans, pumps, hot saws, cold saws, conveyors, straighteners, and drill presses, but is not favoured for table drives. In general, the use of alternating-current motors is recommended where constant-speed, non-reversing conditions obtain, and the direct current where large starting torque, quick-reversing and acceleration, variable speed or dynamic breaking are required.

The ratio of alternating current to direct current used will vary greatly in different plants. In general, in those plants where power is purchased and where there are many cranes and variable-speed drives, direct current will probably predominate for auxiliaries about in the ratio of 60 per cent. direct current to 40 per cent. alternating current for voltages of 440, alternating current, or less and of 250, direct current.—*Iron and Coal Trades Review.*

TRADE STATISTICS OF EGYPT.

The following statement, showing the imports of electrical and similar goods into Egypt during the year 1916, is taken from the recently-issued trade statistics. The figures for 1915 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1915. £E.	1916. £E.	Inc. or dec. £E.
Steam engines, including boilers, &c.—			
From Great Britain ...	29,000	32,000	+ 3,000
,, Switzerland ...	—	3,000	+ 3,000
,, United States ...	—	1,000	+ 1,000
,, France	3,000	2,000	— 1,000
,, Holland	2,000	—	— 2,000
,, Italy	2,000	—	— 2,000
,, Other countries ...	1,000	1,000	—
Total	37,000	39,000	+ 2,000
Electrical machinery.—			
From Great Britain ...	11,000	5,000	— 6,000
,, Belgium	1,000	—	— 1,000
,, United States ...	1,000	—	— 1,000
,, France	1,000	3,000	+ 2,000
,, Italy	1,000	1,000	—
,, Switzerland ...	2,000	—	— 2,000
,, Other countries ...	1,000	—	— 1,000
Total	18,000	9,000	— 9,000
Other machinery (except agricultural).—			
From Great Britain ...	39,000	48,000	+ 9,000
,, United States ...	8,000	9,000	+ 1,000
,, France	8,000	13,000	+ 5,000
,, Italy	4,000	3,000	— 1,000
,, Switzerland ...	1,000	4,000	+ 3,000
,, Sweden	—	1,000	+ 1,000
,, Holland	2,000	1,000	— 1,000
,, Other countries ...	2,000	2,000	—
Total	64,000	81,000	+ 17,000
Petrol and benzine motors.—			
From Great Britain ...	19,000	26,000	+ 7,000
,, France	—	1,000	+ 1,000
,, Italy	1,000	1,000	—
,, Switzerland ...	15,000	36,000	+ 21,000
Total	35,000	64,000	+ 29,000
Lamps of all kinds.—			
From Great Britain ...	4,000	6,000	+ 2,000
,, Germany	—	1,000	+ 1,000
,, France	5,000	6,000	+ 1,000
,, Italy	3,000	6,000	+ 3,000
,, Sweden	1,000	—	— 1,000
,, Holland	2,000	—	— 2,000
,, Switzerland ...	2,000	—	— 2,000
,, Other countries ...	2,000	15,000	+ 13,000
Total	19,000	34,000	+ 15,000
Copper, manufactured.—			
From Great Britain ...	5,000	7,000	+ 2,000
,, Germany	1,000	—	— 1,000
,, United States ...	—	2,000	+ 2,000
,, France	5,000	6,000	+ 1,000
,, Italy	1,000	1,000	—
,, Other countries ...	—	1,000	+ 1,000
Total	12,000	17,000	+ 5,000
Scientific instruments.—			
From Great Britain ...	14,000	19,000	+ 5,000
,, Germany	—	1,000	+ 1,000
,, United States ...	2,000	4,000	+ 2,000
,, France	5,000	11,000	+ 6,000
,, Italy	1,000	3,000	+ 2,000
,, Switzerland ...	—	1,000	+ 1,000
,, Other countries ...	2,000	1,000	— 1,000
Total	24,000	40,000	+ 16,000
Electric, telegraphic, and telephonic apparatus.—			
From Great Britain ...	29,000	45,000	+ 16,000
,, Japan	—	1,000	+ 1,000
,, United States ...	1,000	1,000	—
,, France	9,000	16,000	+ 7,000
,, Italy	8,000	15,000	+ 7,000
,, Sweden	1,000	4,000	+ 3,000
,, Switzerland ...	3,000	4,000	+ 1,000
,, Other countries ...	2,000	2,000	—
Total	53,000	88,000	+ 35,000

£E = £1 0s. 6½d.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Underground Signalling Bells.

In your issue of July 27th, 1917, and in previous issues, I have read articles on underground signalling bells, describing various methods of minimising the danger from sparking at the signalling station. These methods range from gas-tight switches placed at intervals along the haulage roads, to specially-wound bells or relays requiring a minimum current for operation.

In no case has any suggestion been made to actually suppress all danger of sparking at the point from which the signals are sent, and it will doubtless interest you to learn of a method of doing this, which I invented in 1914, and which will be placed upon the market at the conclusion of the war by Messrs. Gent & Co., Ltd., of Leicester.

With my method, the usual system, as installed, is retained, having bare wires along the haulage road, the signals being sent by bridging across the wires with a knife, or other suitable conductor. The only alteration is the addition of a special relay near the bell, which has for its function the transference of all sparking to the trembling contacts of the bell itself.

In the accompanying sketches, fig. 1 shows the signal system as usually installed, and fig. 2 shows the alteration by the addition of the special relay.

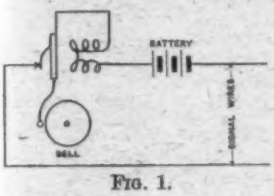


FIG. 1.

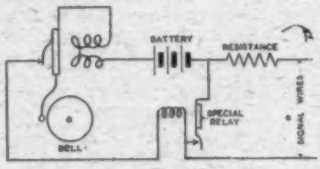


FIG. 2.

This special relay is constructed on the lines of a telephone transmitter, having a very high period of vibration, and consequently able to close or open its circuit in the shortest possible space of time; it is connected with the operating coils in series with the bell, and the contacts are arranged to short-circuit the signal wires. When the signal circuit is closed, by a knife or other means, the relay will vibrate in synchronism with the bell hammer. Sparking can only take place on the signal wires if the current is broken there; therefore, let us follow what occurs when the signal wire circuit is opened at any period during one complete stroke of the bell:—

When the bell-hammer is against the gong, the bell circuit is broken at the trembler contacts, consequently no current is flowing through the circuit, and no spark can take place when the signal wires are separated. When the hammer is away from the gong, and the trembler contacts are together, then the signal wires are short-circuited by the relay contacts, and the current for the bell passes through the relay, and not through the signal wires, consequently they may be separated without any sparking taking place. The only time that current flows through the signal wires is during the extremely short period of the lag in action of the relay, and this period is so short (less than 1/1,000 second) that even a hack-saw blade, or a file, may be rubbed across the signal wires with no danger of a spark taking place.

With this relay, all current is broken at the trembler contacts of the bell, and full provision can be made there for their protection against inflammable gases or coal dust. Practically no alteration is required to existing installations, and either alternating or direct current may be used. It should be noted, however, that it can only be used with trembler bells.

In some cases it may be advisable to place a small resistance, as indicated, in series with the signal wires, but the experiments already carried out show that it is not an actual necessity.

A. W. Brown,
Lieutenant, 3rd Manchester and R.F.C.
Prisoner of War, interned in Switzerland.

August 4th, 1917.

The 10-Mile Limit.

Can you kindly let me know what a disengaged (non-eligible) man is to do? If he lives 10 miles away from a berth, he is not allowed to apply. D.O.R.A.

As I am residing in a non-electrical town, have I got to wait till the war is over?

Wolverhampton.

[The local Labour Exchange should be able to advise our correspondent. Otherwise, we recommend a change of residence (duly notified to the authorities).—EDS. ELEC. REV.]

Staff Organisation in Electricity Works.

The recent letters and articles in the REVIEW on electricity works staff have greatly interested the writer, who is engaged in electric supply work. The last article, by Mr. Stubbings, has called for these few remarks.

With most of this article I am in agreement, particularly as to exaggerated ideas of the importance and status of sales managers. Even in much larger stations than 10,000,000 units per annum, I think these officials are regarded as far too important, especially in comparison with the engineering staff. Concerning this latter staff—and chiefly in the generating department—a little mild criticism may be acceptable.

I would maintain that the engineering assistants should possess the necessary scientific technical knowledge to tackle any problem which may arise in the operation of a supply system. At present there are certainly few men in positions of authority in British stations who have the requisite qualifications and scientific ability. There seems to be a tendency for chiefs to unduly favour marine engineers for the position of station superintendent, and they, in their turn, favour marine engineers as their mechanical assistants. With due respect to the qualifications and ability of these men, so far as marine work goes, it is not a satisfactory state of affairs in power-station work. In station maintenance and routine work they generally give satisfaction; but even in the investigation of structural, mechanical, and steam problems they rarely show sufficient aptitude, whilst in electrical matters their confusion of ideas is notorious.

The new position, which Mr. Stubbings proposes, would be rather difficult to introduce into many stations. Most station and mains engineers would resent the incursion of the new official into their domains. But if, due to lack of scientific training of the existing engineering staff, such an official were appointed, I consider he should be looked upon as more than a "glorified meter superintendent." His work should be of far greater scope than Mr. Stubbings proposes—fuel, water, and instrument testing. His status should be higher than station or mains engineer in order to remove any difficulties as to supposed "trespassing" of the technical assistant in their respective fields. Why not give him the status of the old-time chief assistant? Surely, his qualifications and his value to the undertaking merit it.

Such men are obtainable, and can be found filling junior positions in many stations where little respect for their training or ability is accorded them. They languish through restriction of their scope, and after getting wholesomely satiated with many years of shift or routine work, finally leave the electric supply industry. Perhaps they enter the estimating department of a manufacturing concern. Often they go into technical teaching (wherein such a man may be considered as lost to the engineering profession) or otherwise vanish into a charitable obscurity.

Considerations of space restrain me from giving detailed reasons for the above opinions, and from taking up other aspects of the subject equally interesting and important. I trust this expression of ideas may stimulate further discussion.

Engineer.

Employment of Disabled Soldiers.

I should like to put in a remark or two *re* the "insult to wounded officers" in offering them positions in power houses and sub-stations, which I notice "E. M. F." and Mr. Bridges has so ably contested.

Being an ex-sub-station man myself, for the present serving in the Navy in an electrical rating, I think I am in a position to assure you that very few officers have a fraction of the responsibilities of the man in charge of a large plant ashore. It seems to me that their whole ability is concentrated in enforcing and interpreting discipline, and that any deftness or engineering skill is rarely expected of them.

Therefore, these men need feel no lowering of their dignity in accepting a job in a power house; rather, in fact, they ought to feel that they have been given yet another chance of demonstrating their nerve and discrimination.

I am burning to give a few details of the typical old woman's jobs the officers in most cases have, but, having to maintain secrecy, I will conclude by saying that the power supplies require staffs consisting of the smartest and most experienced men, and any wounded officer who is given the privilege of helping to run one should consider that he is still doing his bit, perhaps even more than most of his comrades in the Services.

I think that the REVIEW should have been less hasty in decrying so well-recognised a branch of the electrical profession, which is unfortunate enough to be so badly paid.

D. F. Barton.

August 24th, 1917.

Brighouse.—Mr. A. J. Ashton, K.C., has sat as arbitrator in the matter of Corporation employés' wages. The men had demanded an increase of remuneration bringing them to an advance of 12s. per week on pre-war rates; the Corporation offered only 10s.

WAR ITEMS.

Exports to China.—The "London Gazette" for August 28th contains some further names of persons and bodies in China to whom exports may be consigned.

Import Prohibitions.—By a Proclamation dated August 22nd, the importation of the following goods is prohibited:—
All machinery driven by power and suitable for use in cutting, working, or operating on wood (as set out in the Proclamation).
Electrical motors up to ½ H.P.

Export Prohibitions.—The "London Gazette" for August 28th contains particulars of certain alterations in the Schedule of Prohibited Exports. The following heading is deleted:—(A) Telegraphs (including wireless) and telephones, and instruments and material for; and in its place there is substituted:—(A) Telegraphs (including wireless) and telephones, and instruments and materials for, including valves for wireless telegraphic apparatus.

The Trade Press and War Loans.—We have received from Mr. Walter Judd, of Messrs. Heywood & Co., Ltd., a communication expressing the opinion that the technical Press has never received from the Government the recognition that it deserves, and suggesting that those responsible for Government publicity should make use of such organs as mediums for appealing to the great industrial classes when next inviting applications for War Loans.

Cost of Electric Railway Materials in U.S.A.—The *Chronicle* (U.S.A.) quotes from the "Weekly News Letter" of W. S. Barstow & Co. (July 11th) a reference to an article in "The Pretzel," published by the Reading Transit & Light Co., with regard to the increase in the cost of materials essential to public utilities operating electric railways and central stations. The article reads:—

"In a recent issue we called attention to the great advance in prices of some of the materials necessary in the operation of electric power and railway systems. We mentioned coal costing us $200,000 more this year than last, and increases of $80,000 in the annual payrolls of our employés, and an advance of 44 per cent. in the price of steel rails.

"But we were merely scratching the surface. Copper wire, electrical machinery, and a multitude of other things used in constructing, renewing, repairing, operating, and keeping our properties up to the high standard of efficiency which the public demands, are costing a whole lot more than they did two years ago.

"We also must face the handicap of being compelled to place orders for materials from three months to two years ahead of time of delivery. Some materials can scarcely be procured at any price. Steel car wheels, for instance, have practically disappeared from the market. They were last heard of at $18 a piece, but for some time it has been impossible to get anybody to quote a price on them. Cast-iron wheels are selling at $1 80 per 100 lb., on big contracts, compared with $1 45 two years ago, an advance of about 25 per cent.

"We have noted some figures at random from our purchasing department showing the sharp advance in prices of some materials to-day, compared with two years ago.

"Rails have increased 100 per cent. over normal prices. To-day they are quoted at $55 a ton for delivery a year hence, and for short-time delivery the price is $75 a ton. Two years ago steel rails were selling at $38 20, so that what is regarded as the normal price to-day is an advance of 44 per cent. There is an even greater advance in special track work, which means curves, switches, and the like, the increase in these materials being fully 200 per cent.

"Copper that is required in large quantities for repairs to trolley and electric equipment has nearly trebled its normal price. Copper trolley wire is now quoted at 38 cents a pound, compared with 17 cents in 1915. Copper feeder cable has advanced from 18 cents to 34½ cents a pound in the same period.

"Motor equipment has advanced over 50 per cent., and following are some of the other advances:—

	1915.	1917.
Track spikes... ...	$2 15c. per 100 lb.	$4 per 100 lb.
Steel trolley poles ...	$1 10c. each.	$2 10c. each.
Track plates... ...	2½c. pound.	10c. pound.
Steel and iron bars...	1½c. pound.	4½c. pound.
Cotton waste ...	9c. pound.	15c. pound.
Chestnut ties ...	40c. each.	60c. each.
Cement	$1 29c. barrel.	$2 9c. barrel.
Gravel	$1 25c. ton.	$2 ton.
Crushed stone ...	50c. ton.	$1 ton.

Dilution of Labour and Munitions.—According to an official statement, the Minister of Munitions (Mr. Churchill), accompanied by Mr. Kellaway, Major J. W. Hills, M.P., and officials of the Ministry of Munitions, the Admiralty, and the Ministry of Labour, met representatives of the Engineering and Shipbuilding Trades' Federation at Westminster on Wednesday last week. Mr. Churchill explained to the delegates that the principal object of the meeting was to set up an Advisory Committee of Trade Unionists, the appointment of which had been discussed at previous conferences. He explained the circumstances which had led to his proceeding with the Munitions of War Bill. He stated that, having gone, as he thought, a long way to meet Labour in his action with regard to the Bill, he felt he could now fairly ask Labour to help him. He appealed particularly for assistance from the trade unions in the enrolment of an increased number of war munitions volunteers, and in seeing that dilution on munitions work was carried out to a fuller extent than at present. He would be glad to have the views of the conference on the setting up of works committees. A friendly discussion followed.

Coal Shortage in Germany.—The "Times" publishes the following dispatch, dated August 26th, from its Amsterdam correspondent:—

"Herr Helfferich, in a speech on Germany's coal difficulties in the Reichstag Main Committee on Friday, said that the maintenance of coal production at the present output demanded uninterrupted and intense labour. Especially there must be no strikes, such as unfortunately occurred last month in Upper Silesia. Every strike deprived the front of munitions and the home of the necessary domestic fuel. The Imperial Commissioner for Coal Supply gave a long explanation of the proposed methods for coal saving, stating plainly that the coal supply was inadequate to the demand. War industries, he said, must be first supplied, and less important consumers must suffer restriction. No system of distribution was possible without hardships. Apart from technical difficulties in the way of greater output, there were difficulties connected with labour, the number of miners being fewer, and their working capacity diminished. In the debate, a member of the Centre said that the average working capacity of miners was less, and was partly due to malnutrition. The strike in Upper Silesia had caused a falling off of about one million tons, which could hardly be made up by withdrawing miners from the front. Industry was of opinion that proper measures would have ensured sufficient coal for an average winter, and that lack of foresight had caused the present situation. The stoppage of works now ordered was the cause of extraordinarily great injury to industrials. The measures contemplated against the smaller industries were simply shocking."

Exemption Applications.—Middleton Tribunal has given conditional exemption to a permanent-way repairs labourer (37, C 2), appealed for, on account of the shortage of labour, by the Electric Traction Co.

At Aberdare, the U.D.C. appealed for Mr. A. J. Abraham (41), chief engineer and tramway manager, and he was given six months on condition that he continues in the same occupation.

At Oxford, Messrs. Wyatt & Son, of St. Giles, appealed for E. Green (35, C 1), engaged on electrical work. He was given two months' temporary exemption.

At Maidstone, Mr. Micklewright appealed for the retention of F. R. Edwards (27, B 1), electrical engineer, and he was given three months, with the Volunteer condition.

Hull Appeal Tribunal has dismissed Military appeals against exemption held by four drivers on the Corporation trams, and in a fifth case exemption until September 1st was substituted. It was stated that women drivers were not able to bear the strain, and that the Amalgamated Association of Tramway and Vehicle Workers was opposed to women drivers.

As the result of a Military appeal, exemption granted until November 23rd to an electrical engineer (39, B 1) with the Brandon and Byshottles Co-operative Society has been made final.

Surrey Appeal Court has granted three months' exemption to E. Lown (31, Class A), electrician, appealed for by Messrs. A. E. Read & Co., Farncombe Paper Mills.

On the appeal of the Military, Faversham Tribunal has cancelled conditional exemption held by E. R. Epps (34), switchboard attendant at the Corporation sewage works. He is not to be called up until October 13th.

With the assent of the Military, three months' exemption has been granted to C. W. Read (36), shift engineer at the Reigate Corporation electric light works.

At Aylesbury, Messrs. Mackrill & Sons appealed for T. Pearce (40, Class A), electrical engineer, on the ground that he was indispensable, his work including an installation at the Royal Bucks. Hospital. The Tribunal gave conditional exemption whilst working at the hospital.

The Military applied at Bexley for the withdrawal of certificates of exemption held by M. M. V. Roots (32, B 1) and H. J. Sheridan (29, Class A), motormen on the U.D.C. tramways. It was stated that it was very important that the men should be retained on account of the fire at the Dartford tramway sheds. Owing to these circumstances, the Military Representative agreed to the appeals being respited.

At Battle, exemption was sought for C. D. Gear (32, A 1), electrical engineer to Viscount Hythe, at Normanhurst Hospital. The appeal was respited for a month to see if a substitute can be found.

Derbyshire Appeal Court has refused exemption to the electrician at Aston Hall, appealed for by Colonel Winterbottom.

Before the Hants Appeal Court, the Bournemouth Electricity Supply Co. appealed for a switchboard attendant (18). The company stated that 130 employés were serving in the Forces, and only six of the 13 men of military age left were

in Class A, and a substitute could not be found for the man asked for. Conditional exemption was conceded.

At Sheffield, final exemption until September 30th has been granted to T. C. Pye (20, B 2), electrical engineer.

At Brighton, a review was made of three months' exemption granted to an electrical engineer (38, C 2), the Military contending that, although he was on munitions, he would be still more useful in the Army. The Tribunal decided to deal with the case again when the present exemption expires.

A Buxton firm of electrical engineers appealed for an electrician (33), the only man left available for work at hydros, hotels, and military establishments in the town. Lieutenant Kersley: "I know what electricians are, and that it is impossible to replace them." Exemption was granted until January 1st.

Cookham (Berks) Tribunal has refused a request for W. J. Windsor (35, C 1), electrician at Stubbings, Maidenhead Thicket.

At Forfarshire Appeal Tribunal, a discussion took place with regard to the position of Mr. C. B. Burnett, resident electrical engineer at Brechin electricity works, whose exemption had been cancelled by the Burgh Tribunal, with the proviso that a substitute should be provided by the Military authorities. An agent mentioned that an effort had been made by the authorities to substitute this man by a mechanical engineer, who was absolutely useless for such work, and he asked for a certificate of conditional exemption. Sheriff Neish pointed out that the onus was placed upon the Military authorities of providing an efficient substitute, and the local Tribunal's finding was confirmed.

REVIEWS.

Electric Traction. By A. T. Dover, A.I.E.E., Lecturer on Electric Traction at the Battersea Polytechnic, London. London: Whittaker & Co. Price 18s. net.

This book professedly deals only with the technical considerations involved in the application of electric power to the working of tramways and railways, and is in the main a text-book for technical students, the outcome, doubtless, of the author's experience in his position at the Battersea Polytechnic. Nevertheless, the influence of financial considerations upon technical design, choice of plant, &c., is by no means ignored, and the effect of Board of Trade regulations on the same matters is duly weighed.

A commendable feature is that the book opens with a list of symbols, explanations of the conventions followed in diagrams, and a list of abbreviations, so that in any uncertainty the reader knows where to look for the meaning of the symbols used.

The introductory chapter gives short descriptions of the systems in use, with reference to practical examples, and tabulated data of the principal electric railways.

The advantages of electric traction on railways are shortly set out, and the principal difficulty in the way of main-line electrification is summarised as the excellent performance of the steam locomotive for fast passenger service, coupled with the cost of conversion.

In Chapter II, the mechanics of train movement, the fundamental "speed time" curve is introduced and studied. Typical curves for "city," "suburban," and main-line services are given, and stress is laid upon the differences in the proportion of acceleration, deceleration, and free running required, and the consequential differences in the motor characteristics needed for each. The importance of acceleration in short runs, and the limitations imposed on acceleration by the weight of equipment, peak load on stations, comfort of passengers, financial considerations, maintenance of rolling stock, and cost of energy, are well set out. The relation between acceleration and retardation, and the economic value of high retardation in saving energy by prolonging the coasting period permissible on a given running schedule is emphasised. The value and low cost of high retardation compared with a corresponding increase in acceleration is very clearly brought out. Actual obtained values are given, and the importance of correct design in this respect in relation to financial results is well shown.

The use of simplified speed-time curves for preliminary calculations is explained very clearly and fully, and the construction of such curves is illustrated with figured examples. In the course of this discussion the author gives adequate space to the importance of short stops on urban services involving short runs, showing the economy to be gained by cutting down the station time. The consistent use of the accepted term "schedule speed," *i.e.*, the distance between stops divided by the time from start to start, and "average speed," distance between stops divided by time from start to stop, assists this exposition. The calculation of the minimum acceleration needed to obtain a given schedule speed, with given retardation, is demonstrated by worked out examples.

In the method adopted by the author, the relations between acceleration, maximum speed, average speed, and retardation are expressed in a form which has a rather complex appearance, and, in fact, involves some tedious arithmetic. For example, on page 12 the expression for maximum speed is given as:—

$$V_m = \left(\frac{\alpha\beta}{\alpha+\beta}\right)T - \sqrt{\left(\frac{\alpha\beta}{\alpha+\beta}\right)^2 T^2 - 7{,}200\,D\left(\frac{\alpha\beta}{\alpha+\beta}\right)}$$

Where V_m is maximum speed, α = acceleration in mile per hour per second, β = retardation in same units, v = average speed in miles per hour, D = distance in miles between stops, T = running time in seconds. This formula gives correct results, but, unfortunately, in working out an example on page 25 an erroneous answer is printed, 24.8 miles per hour instead of 25.8, probably a printer's error.

A somewhat simpler-looking and distinctly more easily computed expression can be derived from the simple geometry of the speed-time curve, and is here offered as an alternative. It is very easy to explain to a class on a blackboard:—

$$v_m = v + \frac{v^2(\alpha+\beta)}{\alpha\beta} \Big/ 2\left(T - \frac{v(\alpha+\beta)}{\alpha\beta}\right)$$

v being in this case the average speed.

It is a little curious that writers on this subject make so little use of the elementary fact that the area of a speed-time curve is the distance or length of run—so that all speed-time curves to the same scale between a pair of fixed points must have the same area—and the simple geometrical relations which follow. The author does use that elementary fact, and the full way in which the calculations are set out and their derivation explained is in refreshing contrast to the method one frequently sees in text books, where intermediate steps are silently omitted, on the apparent assumption that every reader knows his algebra as completely as if he were reading for the Tripos. The author's experience with students, the majority of whom cannot have such mathematical readiness, has stood him in good stead in all the mathematical portions of the book, and gives it special value as a work of reference.

From this, the reader passes to a description of the characteristics of continuous-current traction motors, and the way in which motors are selected to suit or fit the speed-time curves derived from the proposed schedule. This work is thoroughly well done, and the suitability of series, shunt, and compound-wound motors for various kinds of service is fully explained.

Illustrations and descriptions of the electrical and mechanical construction of various motors are given, with a considerable explanation of the evolution of the modern D.C. traction motor, and the reasons which have led to the particular materials and constructive features now in use. The mechanical part is as fully discussed as the electrical.

Single-phase and polyphase traction motors each have a chapter to themselves. Probably there is no other English book on the subject which gives such complete details of these two types of motors in all their variety. This is particularly true of the chapter on single-phase motors, which are, perhaps, less well understood by the average traction engineer than any others.

The same characteristic thoroughness of description and co-ordination between theory and design is continued through the chapters dealing with motor control. These chapters form the most complete account of electric traction equipment in these departments which has fallen our way.

In a chapter on regenerative braking, a good deal of information is given, and if this is not quite up-to-date in respect of continuous-current work—*e.g.*, nothing is said of the recent American railway developments—it must be admitted in extenuation that the best examples are of very recent date, and descriptions may not have been accessible at the time of writing. Enough is said to show the modern line of development.

The same characteristic of thoroughly detailed description pervades the remainder of the book. Chapters XIX, on the calculation of speed-time curves and energy consumption, XXIV, on overhead construction for tramways, XXVI, on feeding and distributing systems, and XXVII, on sub-station converting machinery and switchgear, may be specially commended, because they give detailed expositions of the principles involved, the material available, and practical methods of design involving economical considerations, in branches of the subject on which detailed and consecutive teaching is not very readily available.

The book is, on the whole, a valuable compendium alike for the student of electric traction engineering and for the engineer in practice, a text-book and hand-book in one. There is very little room for criticism, and it can be thoroughly recommended for both uses. Naturally, it must fall out of date as a hand-book of current practice, that is inevitable in an art which is advancing so rapidly as electric traction; the remedy is later editions, which ought to be called for in a reasonable time.

The illustrations are copious, well selected, and well presented. The line drawings are particularly good, and many of the photo-blocks much clearer in detail than the average of such illustrations.—H. M. S.

"SYSTEM."

[COMMUNICATED.]

Every successful business undertaking is dependent for its success upon the adoption of some form of system in the organisation and control of its various departments and the work that they carry out. To the electrical engineer or manager of an electric supply undertaking, therefore, devolves the necessity for formulating a general system for the efficient working of his department, and for the preservation of accurate and accessible records of the growth and working conditions of his particular undertaking.

That such arrangement will necessarily involve many intricacies foreign to many ordinary business concerns will be at once apparent to all who have had experience in the management of an electric supply department, or who have made a careful study of the facts and figures relating thereto, and, for this reason, there is a grave danger that the electrical engineer who is not the possessor of a keen business ability will fall into the error of adopting a system that is either not complete, or, on the other hand, too complete. Each is as bad as the other.

System, like armour, may be made so heavy that all freedom of motion is lost; whereas, on the other hand, it may be so elastic that it fails to afford the protection that is duly expected from it. Yet it is possible to point out undertakings that are suffering under either one or the other of these evils. A system which cannot be relaxed to meet special conditions, but is most rigidly adhered to in all circumstances, is "red tape," the abhorrence of so many of our Government Offices in past days, and has been the means of losing many a good consumer of electricity. It has often occurred that a prospective consumer has required current very urgently at short notice, but this has been denied him on account of the formalities necessary before such supply could be given. He then applies to the local gas company, who are usually only too anxious to meet his requirements, and thus add another to their already long list of consumers literally snatched from the hands of their electrical competitors. Gas companies seem to have a happy knack of securing very alert business men to manage their affairs. The true explanation may lie in the fact that most gas companies are privately owned, and that their managers are, therefore, more free to speculate in the company's interest than is the tied engineer of a Corporation electricity department, who can do little in this way without the consent of the Electricity Committee. Be that as it may, the fact remains that many an electrical consumer has been absolutely sacrificed on the altar of system.

Against this must be recorded the case of the consumer of electricity who was actually connected and using the light for nine months before the fact was discovered. The system in this case was capable of too much relaxation, and consequently a temporary connection was made late one evening, unauthorised by any head of the department, and remained temporary, without a meter, for almost a year.

Too much centralisation in the management of the affairs of a supply company is, as a rule, the result of over-systematising the concern. In such a case, the concern is rarely a "going" one, for no matter how clever or how keen the chief may be, it is almost beyond human possibility for one brain to organise and control every detail in an undertaking of any size. Under the chief, therefore, must be appointed responsible assistants to whom must be entrusted the arrangements for the proper carrying out of the work.

The chief who says that no information must be given except by himself or through the office, is centralising the work too much, and the assistants under him must feel very small when asked a question, to have to reply, "I must not—or cannot—give this information, but the chief will answer any question if you care to write to him." At the same time, it is not advisable to allow every man employed to answer any question that may be put to him, for if this is permitted, a great deal of time and trouble is likely to be taken up in correcting false or incomplete information.

Rules and regulations for the guidance of officials and workmen are, in their way, excellent things, and many would be quite useless without them; but too many rules and regulations are disastrous, in that they so restrict the employé that in an extraordinary case he does not know how to act, and is afraid to adopt a method of his own. Consequently his initiative is destroyed, and the application of common sense to every-day problems becomes through want of practice quite beyond his mental capabilities.

A good chief will always welcome suggestions from any member of his staff, and will not discourage any of his men by telling them they are not paid to think.

Repetition and over-lapping in clerical work should be very carefully avoided. This is not always easy, especially in the consumers' department of a Corporation supply undertaking where all money matters are dealt with by the borough treasurer; but if there are difficulties over the question of the simplification of the rendering and collection of accounts, there is no great difficulty in keeping an excellent record of connections and all matters relating to them without duplicating and repeating everything.

The writer knows of one place where a daily and monthly report gives exactly the same information. Either one or the other is superfluous, but both have to be sent in.

For the proper keeping of records a system of printed forms should invariably be used, but these can and should be kept down to reasonable numbers. There is no need for an average supply undertaking to have forms running into hundreds.

The best system for practical utility is, without doubt, the card index system. For consumers' work there should be three distinct cards. The first card should show particulars of the service, pressure, date connected, and apparatus on circuit. These cards can be arranged in street order. The second card, arranged alphabetically, will enable any consumer to be picked out with ease. This card can well show the meter number and any other metering particulars according to the method employed. The third card must be purely a meter stock card, showing particulars of tests on the meter and its general history, where and when installed, and removed.

To enable the mains engineer to do his work in a quick and efficient manner, he should preserve a careful record on large ordnance maps of every inch of main laid. He should also keep a register of all faults that develop, the causes of them, and the remedies. This record must be properly arranged, so that when a fault develops he can turn up the past history of the section involved, and probably gather from this history a good idea of the cause of the present trouble, and where it is likely to be. This knowledge can largely be carried in the head of the engineer concerned, but it is not system to rely on one's memory, and, after all, the best of memories need refreshing at times.

In the central station the whole working is more or less of a systematic nature, and the records to be kept are in practically every case of a similar kind. Consequently, those strange admixtures of system and chaos which are encountered outside are not so frequent inside.

The standardisation of electricity supply practice is something that the majority of those concerned in the business would welcome, but it can only come through proper organisation. Every engineer must, therefore, realise the value and necessity of system by practising it himself, but he must not allow himself to become "system mad," because it is as bad markmanship to fire over the target as it is to fall short of it.

The 1886 Co.: Strange Development.—The Moscow Town Governor, N. I. Astroff, has received from the Assistant Minister of Trade and Industry information respecting the conditions on which the Provisional Government is disposed to liquidate the 1886 Co. As is known, the original Town Duma calculated that the shares of the 1886 Co. should pass over to the town at their nominal value, but the Duma afterwards changed its point of view, and found it necessary to state that the price of the shares, in consequence of the new industrial laws, should be reduced by 20 per cent. However, this view of the Town Duma not only was not taken into consideration by the Provisional Government, but it even fixed the price of the shares at 160 roubles. The announcement of the Assistant Minister caused complete confusion in the Council, for the new conditions were so onerous for the town, that even the old Government would not have agreed to them. Therefore, the Town Government has sent specially to Petrograd a member of the Council, L. N. Lyutoschenko, who will submit a report to the Assistant Minister, and supplement it with his personal explanations.

BUSINESS NOTES.

Book Notices.—"Conditions in Germany." London: Boswell Printing and Publishing Co., Ltd. 3d.—Thirty-page pamphlet discussing the accumulating Press and other evidences that inside Germany there is no longer the old unity, confidence, and expectation of success in the war, and that matters appear to be taking the inevitable downward course. The pamphlet is written anonymously.

Brazil Commercially Considered. London: The Syren and Shipping, Ltd. 5s. net.—In the 106 pages of fully illustrated matter contained in this publication the publishers have set forth the first results of a tour of Brazil, Argentina and Chile, which was made on their behalf by a Special Commissioner, Mr. D. Paterson Maitland, with the object of helping British trade in South America after the war. The articles are very numerous, and cover many aspects of Brazilian affairs. The history of Brazil, its geography and economic progress, its foreign trade, its waterfalls and their industrial potentialities, its different industries (rubber, cotton, sugar, mining, meat, &c.), and many other such matters are reviewed and described; finely illustrated descriptions appear of the undertaking of the Brazilian Traction, Light and Power Co., Ltd., and the Rio de Janeiro and Sao Paulo systems, also of the system of the Companhia Telephonica do Estado de Sao Paulo. Some pages are devoted to an account of shipping services, especially that of the R.M.S.P. Co. Altogether, the work contains a great deal of information which should be of use to firms who are interested in export trade to Brazil.

"*Journal* of the Institution of Electrical Engineers" and Index. Vol. LV, No. 268. July, 1917.—This issue contains the following papers:—"Magnetomotive Force of Armature Windings," by Mr. B. Hague; "Magnetic Shielding of Large Spaces," by Prof. E. Wilson; "Pressure Drop Curves for Copper Overhead Lines," by Mr. G. N. Wright; also the twelfth list of 63 members on military service.

"Registration and Publication of Directors' Names, under the Companies (Particulars as to Directors) Act, 1917." By Herbert W. Jordan. London: Jordan & Sons, Ltd. 6d. net.

"Miniature Electric Light." By B. E. Jones. London: Cassell and Co., Ltd. Price 1s. 3d. net.

"La Formation des Ingenieurs en France et a l'Etranger." Paris: Libraire, Armand Colin. Price 2 fr.

"*Proceedings* of the Physical Society." Vol. XXIX, Part 5. August 15th, 1917. London: The Fleetway Press. Ltd. Price 4s. net.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXVI, No. 8. August, 1917. New York: The Institute. $1.

Report No. 19 of the Second Section of the Electro-Technical Laboratory, Tokio, on "Telephonic Transmission Losses of Bridged Impedances, Series Resistances and Capacitances."

Trade Inquiries.—According to the *Board of Trade Journal*, a Brisbane firm of electrical engineers and merchants desires to get into touch with firms in this country supplying electric motors and generators, accessories, wires and cables, fittings, batteries, lamps, &c., with a view to representing them in Queensland.

The Acting British Consul at Turin reports that a firm of manufacturers' agents in that city desires to obtain agencies for United Kingdom manufacturers of machinery and electrical apparatus, who may obtain the name and address of the firm referred to on application to the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C. 2. (Inquiry No. 315.)

Electrical Trade in South Africa.—The *S.A. Mining Journal* for July 7th states that the shortage of household filament lamps is getting into the acute stage, as the wholesale houses are said to be out of the 50-c.p. globes, therefore many of the shops either have to use 32 or 100 c.p. "The price has advanced from 6s. to 9s. per dozen for all lamps. There is a demand for small electric meters, as property owners are being compelled to protect themselves against the unfair consumption for radiators, electric kettles, irons, &c. In one instance, a block of rooms in the less fashionable part of the town, under a Kaffir caretaker, used over £20 worth of current last month, as compared with an average of £6. This extra could only be accounted for by the use of radiators and other warming apparatus, as a set-off against the cold weather experienced of late. The Municipal Supply Branch has given notice that owing to there being no suitable cable, due to circumstances arising out of the war, the Town Council is unable to entertain new applications for electric supply in Johannesburg and 26 suburban townships."

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—New 20-page list of illuminated glassware. It is printed very attractively in three colours, a life-like effect being given to the various illustrations of glassware by the use of coloured background panels. The types of glassware listed and illustrated are the well-known types of glass associated with the name of the company—Veluria, Alabas, and Calla. The list also illustrates new forms of Veluria dishes and bowls, and a new type of glass known as "Druid," which is similar to Alabas, but less expensive. Two pages are devoted to listing and illustrating pure alabaster bowls. Copies of the list have already been distributed to holders of the B.T.H. Lamp and Wiring Supplies Handbook Binder.

Messrs. Johnson & Phillips, Ltd., Charlton, London, S.E. 7.—Three new illustrated leaflets:—No. 5 (8 pages) shows the company's standard range of underground non-disconnecting boxes (straight through, three-way, four-way) for all types of cables, also armouring clamps and wiping glands; No. 1 (2 pages) tabulates particulars of J. and P. switch fuses (tubular pattern); and No. 2 (2 pages) deals similarly with isolating switches.

Trade Announcements.—Messrs. Brooks' Electrical Supplies Co. have commenced business as dealers in electrical supplies at 3, Godliman Street, London, E.C. 4. Mr. Alex. D. Brockhuijsen (Dutch) is the sole proprietor.

The Enterprise Maufacturing Co., Ltd., state that they have terminated their arrangements with Messrs. Andrews & Co., and have appointed as their sole agents for Scotland Messrs. Paterson & Service, 38, Bath Street, Glasgow.

Liquidations.—Rural Districts Electric Undertakings, Ltd.—Creditors must send particulars of debts, &c., to the liquidator, Mr. G. W. Brown, 24, Martin's Lane, E.C. 4, by August 31st.

Leitner Electrical Co., Ltd., Maybury.—A second dividend of 1s. in the £ is payable on September 10th at the offices of Messrs. Corfield & Cripwell, 119, Finsbury Pavement, E.C.

LIGHTING AND POWER NOTES.

Argentina.—The Buenos Aires Provincial town of Patagones has been without public lighting for some time past, the service having been suspended by the company owing to non-payment of the debt due to it by the community.

The inhabitants of the town of Pergamino (Province of Buenos Aires) were notified recently by the local management of the electric light company (Compania de Electricidad de la Provincia de Buenos Aires) that the service would be suspended in view of the difficulty the company had in collecting the municipal lighting debt, which amounts to over $107,000 m/n.

At the last moment an arrangement was come to for the continuance of the service, the Municipal authorities giving to the electric company the blank receipts for public lighting collectible from householders, and renewing their "pagaré" for $41,149.94 m/n., which fell due on May 1st last.

It is reported from San Justo and from San Antonio de Areco (both in the Province of Buenos Aires) that the local electric light companies have the intention of suspending the public service owing to non-payment of accounts by the communal authorities.—*Review of the River Plate.*

Burnley.—The electrical engineer has reported to his Committee that, owing to the shortage of refuse for fuel, the coal consumption has been seriously increased. He has prepared a statement showing the failure of supplies, and this is to be submitted to the Cleansing Committee.

Crayford.—Street Lighting.—The West Kent Electric Co. has informed the P.C. that it cannot supply current for public lighting on London Road until the further mains are laid towards the parish.

London. — Hammersmith. —Price Increase. — The Electricity Committee has had under consideration the financial position of the electricity undertaking, more particularly the revenue now received in respect of supply to consumers. The Committee points out that the present charges for supply were fixed in 1905. The increase in the output during the past few years alone has enabled the Council to delay making any advance in the prices, but owing to the greatly increased generating costs (coal alone being 11s. per ton in excess of the price paid in 1913-14), and the high prices of materials, new plant, &c., the Committee recommends that, as from September 29th next, the charges for lighting and power, including special supplies, be increased by 12½ per cent.

Rawmarsh.—A Sub-Committee of the U.D.C. is to meet the Rotherham Electricity Committee on the question of supplying power in the Rawmarsh district.

Southend-on-Sea.—A motor-generator for charging at the refuse destructor the batteries of electrical-driven tip wagons for dust collection is to be purchased, with other plant, at a cost of about £500.

Stalybridge. — The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has resolved that motor rentals be increased by 20 per cent. from January 1st, 1918, and that notice of the increase be given to consumers.

Straits Settlements.—George Town (Penang) Electricity Department.—The report of Mr. O. V. Thomas, engineer and manager of the municipal electrical undertaking, on the year's working (1916) shows that 1,697,619 units were sold, an increase of 5·8 per cent. on the previous year's figures; the revenue amounted to $304,193·42, representing an increase of $31,418·31, or about 10·3 per cent.; the gross profit was $201,139·23 (being 19·5 per cent. on the total expended capital, as compared with 18·22 per cent. in the previous year). After paying all charges due to capital there remained a net profit of $97,703·87, or approximately 9·5 per cent. on the capital expended. At the end of the year the total number of installations being supplied was 2,676, with an aggregate demand of 87,395 30-watt lamps, representing a net increase during the year of 388 installations, with a demand of 10,779 30-watt lamps. During the year capital expenditure was forcibly restricted by war conditions; a spare balancer set (cost $2,600) was ordered for No. 1 sub-station, and arrived during the year. The total costs per unit sold amounted to 7·74 cents and the works costs

to 6·05 cents. During the year four faults occurred on the mains, three in the old V.B. sheathed cables and one in a lead-sheathed cable; the latter was traced to mechanical damage in connection with repairs to water mains.

In his report Mr. Thomas remarks that the question of the reduction of the charges for lighting and power would doubtless commend itself to the Commissioners in normal times, but having in view the fact that any reduction in charges would be followed by an increase in the number of applications for supply, and would hasten the time when capital extensions in plant and mains would imperatively be needed, it has been decided to make no change until the war is ended.

U.S.A.—A recent issue of *Power* described the remodelling of the Ashley Street station at St. Louis. This plant as originally designed had a capacity of 12,000 KW. (in 1903), made up of five vertical-compound reciprocating engines and generators, with 28 Scotch marine boilers.

In 1905, after the station had been in use a little over a year, it was decided to install four 5,000-KW. turbine units, for which space was found in the engine room, and to provide steam, 40 water-tube boilers were installed on a second floor in the boiler house.

In 1908 it was found necessary to further increase the plant, and 12,000-KW. turbine sets were installed in place of the 5,000-KW. sets, the original condensers and auxiliaries serving for the new plant. Twelve of the old marine boilers were replaced by a similar number of Babcock boilers, and the capacity of the station reached 64,000 KW.

In the meantime, the Keokuk hydro-electric plant was built, and the St. Louis Co. obtained further power from that source for several years.

In 1915, however, it was decided to increase the steam plant by substituting a 20,000-KW. horizontal Curtis turbine set for one of the orginal reciprocating sets. The generator is a 4,500-volt, 60-cycle, three-phase unit, with four poles, and is rated at 20,000 KW. at 80 per cent. power factor; speed, 1,800 R.P.M.

To supply additional steam, the remainder of the old marine boilers were removed, and 10 modern water-tube boilers replaced them. It is intended to proceed with this substitution by large plant units to bring up the station-plant capacity to 116,000 KW.

Tests on the latest turbine show that it is running well under the guarantees of steam consumption, viz., 11¼ lb. per KW.-hour with 1 in. absolute back pressure, 225 lb. steam pressure, and 150° of superheat.

When the present plans are complete, the original station designed for 12,000 KW. will contain an installation of 116,000 KW.

Wigan.—PRICE REVISION.—The Corporation has given notice that the scale of charges for electricity supplied for power purposes by the Corporation to all ordinary consumers will, as from October 1st, 1917, be revised as follows:—For the first 500 units supplied per quarter, 2d. per unit; between 500 and 1,000, 1½d. per unit; between 1,000 and 1,500, 1¼d. per unit; between 1,500 and 2,000, 1½d. per unit; and for all over 2,000, 1d. per unit, plus in each case 25 per cent.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—A Corporation car proceeding along Lytham Road on August 25th ran off the line; the driver was injured, and had to be removed to hospital.

Bolton.—The rail wear problem is being solved at Bolton by the employment of the Woods-Gilbert rail planer, recently described in our pages, a couple of which machines are now at work in the borough. On the invitation of the Woods-Gilbert (British) Rail Grinding and Milling Co., representatives of various tramway authorities in Lancashire met at Bolton, last week, to see the machines at work. The borough engineer, Mr. E. Ll. Morgan, who is responsible for the maintenance of the track, has recommended that 44,667 yards of single rail require to be re-grooved, 16,710 yards to be planed, and a large number of joints treated for "hammering." The contract price for the whole of the work is £6,140. He considers that the cost of removing the corrugations, £1,253, should be charged to revenue, and the balance would thus work out at £383 per mile of track treated. Even if only three years are added to the life of the rails, the saving of the depreciation fund by the extended life of the track will amount to £552 per mile.

Bradford.—HOLIDAY TRAFFICS.—Approximate figures of the tramway traffic during the Bowling "Tide" week—an increasingly popular general holiday for a big proportion of the industrial population, which immediately follows the Bank Holiday period—show greatly increased takings as compared with last year. The bookings of through tickets between Bradford and Leeds for this period totalled 25,200, as against 22,400 for the same period last year, though last year there was a 10 minutes' service, as against a through-car 15 minutes' service this year, owing to labour shortage.

Dover.—A B. of T. inquiry has been held regarding the recent tramway accident, which resulted in 11 persons being killed and 59 injured.

At the Coroner's inquest, held on August 29th, a verdict was returned that the accident was due to an error of judgment on the part of the driver, whom it was considered was too inexperienced.

Glasgow.—The traffic receipts of the Corporation's tramways last week were £25,901, as compared with £23,638 in the corresponding week of August last year, and the number of passengers carried, 7,883,645. The car-miles run were 509,940. Compared with last year, there is an improvement on the receipts since the beginning of the financial year on June 1st, the figures for 1917 being £296,800, as against £264,256.

Ipswich.—In order to save time and expense in the maintenance of the cars, and also in view of the frequent collisions between cars and other vehicles in the streets due to the absence of street lighting, the Corporation has decided that, for the remaining period of the war, the fancy painting of the cars shall be abandoned, and that in place thereof the cars shall be painted two shades of grey with a limited amount of black lining.

Leeds.—A recent statement on the Corporation tramway services shows that the receipts since the beginning of the current financial year have increased by over £1,000 per week on the figures of last year, though last year the total income, for the first time in the undertaking's history, exceeded half a million pounds. The actual figure was £515,806. It is confidently expected that this record will be much surpassed at the end of the present year. The receipts of the first 20 weeks of this year are higher by £22,433 than for the corresponding period of last year.

London.—L.C.C.—The traffic returns of the L.C.C. tramway undertaking for the week ended August 22nd show receipts £58,527, as compared with £49,848 in the corresponding week last year. From April 1st to August 22nd the receipts were £1,146,260, as against £1,002,591 in the corresponding period in 1916.

Manchester.—TRAFFIC CONGESTION REPORT.—The Special Traffic Congestion Committee of the City Council has issued its report, and the far-reaching proposals for dealing with a pressing problem, and involving an estimated cost of a million and a-half sterling, are exciting keen comment. The Tramways Committee had pointed out the need for new arterial roads into the city, and other Committees had reported upon the great traffic congestion in the centre of the city. The Special Committee considers that there should be a limitation of tramway traffic within a certain prescribed area in the centre of the city, that additional arterial routes should be opened out, and that tramway terminals should be established. The following sites are suggested as terminals:—Old Infirmary site, St. Peter's Square, Cannon Street, Albert Square, Marsden Square, and Stevenson Square. The Congestion Committee is of opinion that these terminals are absolutely necessary, and by their adoption the number of cars passing along the principal streets in the centre of the city can be reduced by at least 50 per cent.

Nottingham.—Due to a car which was descending Derby Road temporarily getting out of control, several alarmed passengers attempted to jump off, and six of them were removed to the hospital for treatment of their injuries.

Straits Settlements.—GEORGE TOWN (PENANG) TRAMWAYS.—During the 11th year of operation the municipal tramways carried 5,560,398 passengers, as compared with 5,177,874 in the previous year; the car-mileage was 502,731. The total revenue during the year amounted to $151,408·42, and the operating costs to $91,735·95, or 18·40 cents per car-mile.

TELEGRAPH AND TELEPHONE NOTES.

Australia-New Zealand Telegraphs.—The first message by the new Eastern Extension cable from Wellington to Sydney was sent by Sir Joseph Ward on August 23rd.

Leeds Wireless School.—Under instruction of the Marconi Co., in co-operation with the Admiralty, the Leeds Education Authority is to undertake the training of wireless operators on a large scale. Early in September a start is to be made with 40 youths, but arrangements are to be made for the provision of training for 200 students at a time, for a six months' course.

South America.—It is reported from Rio de Janeiro that the Brazilian Government has refused to accede to a petition presented by the Marconi Co. for the installation of a high-power station in Amazonas.—*Review of the River Plate.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—MELBOURNE.—October 10th. Department of the Navy. Pumping plant and equipment for the Commonwealth Naval Dockyard, Cockatoo Island, Sydney. Specifications from the Director of Navy Contracts, Melbourne.

Dublin.—September 11th. Electricity Supply Committee. Twelve months' supply of cables, troughing, bends, section pillars, service boxes, &c. See "Official Notices" to-day.

Dunfermline.—September 6th. School Board. Installation of electric lighting at the Rosyth New School. Mr. D. Gorrie, Clerk to the Board, 104, High Street.

London.—Bermondsey.—Sept. 7th. B.C. 500-kw. rotary converter. See "Official Notices" August 3rd.

Stockton-on-Tees.—September 10th. District Fund Gas and Electricity Committees. Stores, &c., for six months. See "Official Notices" to-day.

CLOSED.

Southend-on-Sea.—T.C. Accepted tenders :—

Ransome, Sims & Jefferies.—Four electric 2-ton "Orwell" vehicles, with electric tipping bodies, and "Ironclad Exide" batteries, £932 each.
J. G. Brill & Co.—Tramway castings and journal boxes, £44 11s.

Swindon.—Electric bells and fire-alarms for new factory : Napier-Kimber, Ltd.

Tilbury.—U.D.C. Refuse destructor : Heeman & Froude, £5,308.

NOTES.

Electrolytic Disinfecting Fluid.—During the year 1916, according to the report of Dr. F. W. Alexander, Medical Officer of Health to the Borough of Stepney, 26,790 gallons of electrolytic disinfectant were manufactured, making 53,580 gallons as diluted for distribution. The cost was, for materials, £74 ; electrical energy, £40 ; total, £114 ; on account of the war, the price of materials has considerably increased. Since the installation of the plant, a period of 11 years, 445,569 gallons of the fluid have been manufactured at a cost for electricity of £490, and materials £455 (about ½d. per gallon).

Volunteer Notes.—County of London Volunteer Engineers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week, by Lieut.-Colonel C. B. Clay, V.D., commanding :—
Extract from *London Gazette*, August 22rd :—
County of London Volunteer Engineers.—Lieut.-Colonel C. B. Clay (Lieut.-Colonel, late Lancs. Volunteer Artillery) to be Temporary Major (May 15th) ; E. C. F. Monson (late Major City of London Rifles) to be Temporary Major (second in command) (May 15th).
To be Temporary Captains.—W. D. Bentley, E. G. Fleming, W. Hynam (late Captain, Reserve of Officers), F. M. Yearsley (late Captain, 16th Midx. Volunteer Rifles) to be Temporary Captain and Adjutant (May 15th).
To be Temporary Lieuts.—W. J. A. Watkins, A. J. N. Gerard (May 15th).
To be Temporary Second Lieuts.—P. Bowden, C. E. Campbell. A. Champion to be Temporary Hon. Lieut. and Quartermaster (May 15th).
Officer for the Week.—Lieut. W. J. A. Watkins.
Monday, September 3rd.—Technical instruction (searchlight) for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class, 6.30. Recruits' Drill, 6.30.
Tuesday, September 4th.—Physical drill and bayonet fighting, 7.30.
Wednesday, September 5th.—Drill and elementary bridge construction for No. 1 Company, Left Half Company.
Thursday, September 6th.—Drill and elementary bridge construction for No. 2 Company, Left Half Company. Signalling Class, 6.30. Ambulance Class, 6.30.
Friday, September 7th.—Technical instruction (searchlight) for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.
Musketry.—All N.C.O.'s and men who have signed the "A" and "B" agreements are required to attend during this month to re-classify in order to enable the corps to obtain the capitation grant. Preference will be given to those men in firing. This does not apply to those who hold the proficiency badge.
Armlets.—The new issue armlets can now be had at Headquarters, and every enrolled man must obtain one without delay ; at the same time, all old red armlets (now obsolete) must be returned.
Note.—Unless otherwise indicated, all drills will take place at Headquarters.
(By order) Macleod Yearsley.

War Honours.—The Order of the British Empire.—On August 25th there were published the first lists of men and women who have been appointed to the new Orders instituted in recognition of services rendered in connection with the war. The appointments to the Order of the British Empire include the following :—

Knights Grand Cross.—Lord Emmott, G.C.M.G. (Director of the War Trade Department) ; Baron Moulton, K.C.B., F.R.S. (Director-General of Explosives) ; Sir Eric Geddes, K.C.B. (Transportation) ; the Hon. Arthur Stanley (British Red Cross Society).

Knights Commander.—G. J. Carter, Esq. (Cammell, Laird & Co., Birkenhead) ; Dugald Clerk, Esq. (Board of Invention and Research Admiralty, and Ministry of Munitions Inventions Department) ; C. W. Fielding, Esq. (Chairman of Materials and Metals Economy Committee, Ministry of Munitions) ; A. E. Herbert, Esq. (Deputy Director-General of Machine Tools, &c., Ministry of Munitions) ; John Hunter, Esq. (Director of Factory Construction and of Iron and Steel Production, Ministry of Munitions) ; Prof. H. S. Jackson, F.R.S. (Chemical Adviser to the Optical Research Branch of Ministry of Munitions) ; L. W. Llewelyn, Esq. (Director of Materials, &c., Ministry of Munitions) ; Lynden Macassey, Esq., K.C. (Director of Shipyards Labour, &c.) ; Cecil Partridge, Esq. (Manager and Secretary, Metropolitan Munitions Committee) ; E. M. Pollock, K.C., M.P. (Controller Foreign Trade Department) ; Sir Vincent L. Raven (Deputy-Controller, Navy) ; F. W. S. Stokes, Esq. (Chairman of East Anglian Munitions Committee) ; Richard Threlfall, Esq., F.R.S. (Advisory Council of Industrial and Scientific Research).

Commanders.—Prof. H. B. Baker, F.R.S., Professor of Chemistry, Imperial College of Science and Technology (Ministry of Munitions) ; Leonard Bairstow, Esq., F.R.S. (Chief of Aerodynamics, National Physical Laboratory) ; C. W. Bryant, Esq. (managing director of Messrs. Brotherhoods, Ltd.) ; J. T. Brownlie, Esq. (Amalgamated Society of Engineers) ; Prof. W. H. Bragg, F.R.S. (Board of Invention and Research, Admiralty) ; A. E. L. Chorlton, Esq. (Board of Invention and Research, Admiralty) ; W. Duddell, Esq., F.R.S. (Board of Invention and Research, Admiralty, also Munitions Inventions Board) ; A. S. Esslemont, Esq. (Director of Optical Munitions and Glassware) ; F. W. Harbord, Esq. (Consulting Metallurgist, Ministry of Munitions) ; A. Laing, Esq. (Wallsend Slipway and Engineering Co.) ; C. S. Parker, Esq. (Member of the Commission Internationale de Ravitaillement) ; P. J. Pybus, Esq. (Labour Supply Department of the Ministry of Munitions), Phœnix Dynamo Manufacturing Co., Bradford ; Prof. J. F. Thorpe, F.R.S. (Chemical Advisory Committee) ; Sir G. Croydon Marks, M.P. (Labour Department, Ministry of Munitions).

Officers.—G. Cumming, Esq. (engineering managing director, Harland & Wolff) ; G. K. B. Elphinstone, Esq. (managing director of Elliott Bros., Ltd.) ; M. B. Field, Esq. (director of Kelvin, Bottomley & Baird, Ltd.) ; G. P. Harben (Anglo-Italian Trade Commissioner) ; Prof. J. C. McLennan (Professor of Physics, Toronto University).

Members.—G. H. Baillie, Esq. (Chief Technical Officer, Labour Supply Department, Ministry of Munitions) ; R. Clarke, Esq. (Aviation Electrician, Telegraphist, &c., Admiralty) ; H. Schofield (Principal of Loughborough Technical Institute) ; W. Simcox (Amalgamated Society of Engineers) ; C. Taylor (Amalgamated Society of Engineers).

Inquiry.—The maker of the Angelus electric fire is asked for.

Miners' Wages.—The Executive Committee of the Miners' Federation of Great Britain met the Controller of Coal Mines, on Tuesday, and put before him a request for an increase of 25 per cent. on present earnings. Mr. Smillie, the president, and Mr. Herbert Smith, the vice-president, of the Federation, stated the grounds on which the request was based. The Controller undertook to lay the matter before the Government and to communicate the result to the secretary of the Federation at the earliest possible moment. It was reported that the miners in one of the important Midland areas were at present working out their notices, and threatened to come out on strike unless an immediate advance in wage was given. The Controller of Coal Mines and the Executive of the Miners' Federation expressed the hope that no action of this kind would be taken until the Government had had time to consider the application now put forward.

Charity Sports at Chelmsford.—Three large works in the town—viz., Messrs. Crompton & Co., Ltd., the Hoffmann Manufacturing Co., Ltd., and Marconi's Wireless Works Co., Ltd.—carried out a most interesting sports meeting arranged amongst the employés on the ground kindly lent by the Crompton Club, on Saturday, August 25th. There was a record attendance of the public, who not only had an enjoyable afternoon, but also helped three worthy objects—the Essex Regiment Comforts' Fund, the Essex Regiment Prisoners of War Fund, and the St. Dunstan's Hostel for Blinded Soldiers and Sailors. Most of the events were restricted to employés of the works, but the few open ones attracted large entries, many of the men being in khaki. The races were got off in splendid time, the punctuality being remarkable, and upon this the officials are to be warmly commended. In the reserved enclosure were many wounded soldiers from the local hospitals, these being guests. The prize money was kindly provided by the directors of the three companies. The band of the 270th Battalion provided excellent music, and there were amusements of every kind. The Chelmsford V.A.D., under Instructor Runter, were in attendance, but there were no accidents. Mr. Percy G. Cheverton, of Compton's, acted as hon. secretary. The Executive Committee was composed of three representatives from each of the three works. Mr. J. Barker was starter.

The events included running, walking, cycle, hurdle, blindfold, and combination races, and tug-of-war. Crompton's easily secured pride of place in the matter of prizes, winning 9 firsts, 5 seconds, and 5 thirds ; Marconi's were second with 5 firsts, 5 seconds, and 3 thirds ; while Hoffmann's secured 2 firsts, 5 seconds, 5 thirds. The prizes were distributed by Mrs. Britten, wife of Mr. Thomas Britten, director to Messrs. Crompton & Co., Ltd. Thanks to Mrs. Britten were voiced by Mr. T. Clarkson, and Mrs. Britten suitably replied. Mr. Geoffrey Barrett thanked the hon. sec., Committee, and officials, and Mr. Percy G. Cheverton acknowledged the compliment. In the evening a grand *al fresco* concert took place on the bowling green, and there was a record attendance ; several London artistes appeared. During the interval of the concert, a very popular draw took place, for which 2,500 tickets had been sold. The first prize was a bicycle ; the second, two War Savings Certificates ; and the third, one War Savings Certificate. There was also dancing, the music being provided by the Yorkshire Regiment Band.

Road Damage by Motor-'buses.—Mr. Chapman, the surveyor for Kent, in a report to the County Council on the damage done to main roads by motor-'bus traffic, states that 314 miles of county main roads and 104 miles of borough and urban roads carry this traffic. He estimates that £550,000 would be required to re-surface with bituminous material those of the main roads not already so treated, including the cost of strengthening the roads, and suggests that legislation is necessary to ensure a more adequate contribution from heavy and high-speed traffic for this purpose.

Strike at Belfast.—With reference to a strike of members of the Electrical Trades Union employed in the tramways department of Belfast Corporation, we learn that a number of men in the electricity department have been called out in consequence. We understand that the dispute arises out of a difference of opinion between the manager of the tramways and the Electrical Trades Union as to whether or not the men engaged in maintaining the overhead equipment of the tramways should be paid the standard rate for electrician's work.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of August 30th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Italy, Japan, and the Netherlands. The Supplement also contains the list of articles (complete to date) which are prohibited to be exported from the United Kingdom.

Institution and Lecture Notes.—Iron and Steel Institute.—At the autumn meeting to be held on September 20th and 21st at the Institution of Civil Engineers, London, the following papers are down for consideration :—

G. Barrett and T. B. Rogerson, "Present Practice in Briquetting of Iron Ores."
W. J. Brooke and F. F. Hunting, "Microstructure of Commercially Pure Iron between Ar_3 and Ar_2."
E. D. Campbell and W. C. Dowd, "The Influence of Heat Treatment on the Electrical and Thermal Resistivity and Thermo-Electric-Potential of some Steels."
G. Charpy and A. Cornu-Thenard, "New Impact Testing Experiments."
J. E. Hurst, "Heat Treatment of Grey Cast-Iron."
E. F. Law, "Effect of Mass on Heat Treatment."
T. D. Morgans and F. Rogers, "Investigation upon a Cast of Acid Open-Hearth Steel."
F. Rogers, "The Acid Open-Hearth Process."
J. H. Whiteley, "The Eggertz Test for Combined Carbon in Steel."
E. B. Wolff, "Failure of Boiler Plates in Service and Investigation of Stresses occurring in Riveted Joints."

Mr. Gerard's Disclosures.—In the course of Wednesday's contribution to his work "My Four Years in Germany," in the *Daily Telegraph*, Mr. J. W. Gerard, late U.S. Ambassador in Berlin, mentions a visit paid by himself and Prince Henry, in company with Mr. S. Bergmann, to the Bergmann electrical works. Later he refers to a delayed cable contract as follows :—"Before the war there was but one cable direct from Germany to America. This cable was owned by a German company, and reached America *via* the Azore Islands. I endeavoured to obtain permission for the Western Union Co. to land a cable in Germany, but the opposition of the German company, which did not desire to have its monopoly interfered with, caused the applications of the Western Union to be definitely pigeon-holed. After the outbreak of the war, in August, 1914, when I told this to Ballin, of the Hamburg-American Line, and Von Gwinner, head of the Deutsche Bank, and when they thought of how much they could have saved for themselves and Germany and their companies if there had been an American-owned cable landing in Germany, their anger at the delay on the part of official Germany knew no bounds. Within a very short time I received an answer from the Foreign Office granting the application of the Western Union Co., providing the cable went direct to America. This concession, however, came too late, and, naturally, the Western Union did not take up the matter during the war."

Hints to Traders with Italy.—The following hints to British manufacturers are taken from the Annual Report for 1916 of the British Chamber of Commerce at Nice :—

"Many German goods are simply cheap imitations of British manufactures. Of course, if and when British labour is fully occupied, it would be undesirable to divert it from making high-grade goods (for which there is a good demand) in order to turn out low-grade goods in which competition is severe. Nevertheless, some German goods, particularly hardware, are exactly suited to certain markets, owing to their lightness and cheapness, and Colonial and foreign buyers often find the German articles more convenient if not of better value. Again, when the British manufacturer refuses to pack his goods in a form convenient to his customers, he deliberately puts himself out of the market. So long as British manufacturers persist in such an attitude they will find it impossible to drive the German trader from the markets where he has been established. At the present time, no doubt, these markets are being tempted to test the dearer and better British goods; but this will not last. In many cases, of course, British goods are better by much more than the difference in price, but where it is impossible to cheapen production the buyer should be stimulated by a more active advertising policy, and by other methods, such as for instance, the placing of goods prominently in wholesale showrooms; the distribution of leaflets setting out in the language of the country the selling points and merits of the particular goods; and by generous advertising in foreign newspapers. The primary need is, however, to supply goods so that they can be disposed of with a minimum of trouble, which is of special consequence where labour is scarce and costly. Another point of great importance is that few manufacturers do their own shipping. They do not realise sufficiently that the price which determines the sale of goods is not the cost at the factory, but the cost delivered in the consumer's market. As regards the ultimate buyer, it makes not the slightest difference whether a low price is brought about by economies in manufacture, packing, freight, or reduction of breakages. If manufacturers are working on too small a scale to do their own shipping at rock-bottom cost, they should either utilise the services of merchants or adopt some co-operative method which will enable them to share in a single efficient and economical selling organisation. If they do their own selling they should realise that it is as much to their interest to make economies in the packing and shipping of goods as in reducing the cost of manufacture."—*Board of Trade Journal.*

Educational.—City and Guilds Technical College, Leonard Street, E.C.—The entrance examination for students who have not matriculated will be held on September 18th.

University of London, King's College Faculty of Engineering.—Next term begins on October 3rd. For full particulars see our advertisement pages to-day.

The Goldsmid Scholarship.—The examination for the Goldsmid Engineering Entrance Scholarship at University College, London, value £30 a year for three years, will take place in September. Candidates should apply to the Secretary of University College, London, for full particulars as soon as possible, and not later than September 11th.

Appointments Vacant.—Five assistant foremen for the Government of India Gun and Shell Factory, Cossipore; switchboard attendant (35s.), for the Swindon Corporation electricity works; wireman-jointer, for the Heckmondwike electricity works; men, with experience of up-to-date power station or distributing practice, are wanted by the Rotherham Corporation; assistant mains superintendent for the Darlington Corporation Electricity Department; charge shift engineer (£250) for the L.C.C. tramway generating station; shift engineer for the Eccles Corporation electricity works. See our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Southend-on-Sea T.C. has declined to allow the electrical engineer, Mr. Birkett, to serve two or four days per week for three or four months with the Coal Control Board. The refusal is owing to the depleted staff.

Major W. A. Vignoles, borough electrical engineer, Grimsby, has relinquished the acting rank of lieutenant-colonel on ceasing to command a service battalion of the Lincolnshire Regiment.

General.—Messrs. Kincaid, Waller, Manville & Dawson have removed to 3, Central Buildings, Westminster, S.W. 1, the Government having requisitioned St. Stephen's House.

In the electrical engineering shop at Rosyth Dockyard, David Adamson, recently a boy writer, was presented with a Carnegie Hero Fund watch for heroism displayed in rescuing a child from drowning. In the presence of members of the staffs of the several departments the watch was handed over by Rear-Admiral H. H. Bruce, Commander Superintendent. Mr. A. J. Ford, of the electrical department, replied for Adamson.

Mr. R. G. Scott, of the Sunderland Forge & Electrical Engineering Co., Ltd., was married on Saturday last in the Wearside borough to Miss F. O. Huntley, local organising secretary of the Red Cross Society.

It is announced that the Minister of Munitions has appointed Mr. A. H. Collinson, who is at present Director of Inspection in Munition Areas, to be Controller of Inspection, in place of Sir Sothern Holland, appointed to the Admiralty for special work.

Roll of Honour.—We regret to learn than Lieutenant J. S. B. Plummer, Leicester Regiment, who only returned to France on the 7th inst. (his return was mentioned in our issue of August 10th) is reported by the War Office to be wounded and missing.

Private R. Floyd, Highland L.I., who has fallen in action, was an apprentice to electrical engineering at the works of the British Westinghouse Co., Ltd., Manchester.

Corporal D. C. Davis, R.E., who has been killed at the Front by a bullet from an enemy aeroplane, was formerly on the staff of the Isle of Thanet Tramways & Electric Light Co., Ltd., and enlisted whilst holding an important position with the Argentine Railway Co. at Buenos Aires.

Rifleman A. Burrows, K.R.R., killed by shell, was employed by the Chloride Electrical Storage Co., Ltd., Clifton Junction.

Rifleman J. Crabtree, K.R.R., killed in action, was an electrician at Rochdale.

Private T. Sutcliffe, Royal Inniskilling Fusiliers, who is in hospital wounded, was employed on the clerical staff at Rochdale Corporation electricity works.

Private W. Parker, King's (Liverpool) Regiment, who has died from heart failure after gas poisoning, was employed by Messrs. Dick, Kerr & Co. Private Bowes, L.N.L. Regiment, also employed by the same firm, has been killed in action.

Second-Lieutenant F. Newton, of the Cheshire Regiment, killed in action, was employed by Messrs. Electromotors, Ltd., Openshaw.

Private E. G. Whitehead, Machine Gun Company, Grenadier Guards, of Manchester, who has been killed whilst serving in France, aged 21 years, was employed at the Clayton electricity works.

Electrical Wireman G. E. Williams, of Marsh Green, Warrington, aged 21, has lost his life at sea. He was serving

on a destroyer which struck a mine. He was a switchboard attendant at the Wigan Corporation electricity works.

Private J. R. Bowes, Loyal North Lancs. Regiment, killed in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Private J. Williamson, Lancs. Fusiliers, presumed killed, after being reported missing, was a former employé of the British Westinghouse Co., Ltd., Trafford Park.

Private N. Dennis, West Riding Regiment, formerly employed in the Halifax Corporation tramways department, has been awarded the Military Medal.

Corporal T. H. Kirby, R.F.A., killed in action, was on the clerical staff of Messrs. R. Galsworthy & Sons, electrical fitters, Leeds.

Lance-Corporal J. W. Albeck, R.E., wounded, was employed at the Bradford city electricity works, Valley Road.

Private J. Prince, of the King's (Liverpool) Regiment, killed in action, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston.

Second-Lieutenant John C. Jackson, Manchester Regiment, reported missing and believed killed, was a student for electrical engineering at the School of Technology, Manchester, prior to the war.

Bombardier W. H. Airey, R.G.A., who has fallen in action, was on the staff of the Croydon Corporation electricity works.

The Military Medal for bravery has been awarded to Bombardier E. S. Howard, R.F.A., who was electrician at the Victoria Hall, York.

Mr. Percy John Pybus, who is a Commander of the new Order of the British Empire, and who is described in the honours list as having rendered valuable services to the Labour Supply Department of the Ministry of Munitions, is the managing director of the Phœnix Dynamo Manufacturing Co., Ltd., Bradford, and is at present in charge of hydroplane construction work. In connection with the work for which he has received his honour, Mr. Pybus carried out an investigation for the Prime Minister with regard to the application of women to the manufacture of munitions, the inquiry leading to the publication of a book by him, entitled "Women on Munitions of War," for which Mr. Lloyd George wrote a preface.

Lance-Corporal C. Bishop, Sussex Regiment, a former employé of the Brush Electrical Engineering Co., at Loughborough, has been killed in action.

Private J. W. Wardell, Seaforth Highlanders, who was employed at the power station of the Leeds Corporation tramways, is in hospital at Etaples wounded.

Private R. Aspinall, of the Loyal North Lancashire Regiment, who was previously reported missing, is now stated to have been killed. He was employed by Messrs. Dick, Kerr and Co., Ltd., Preston.

Signaller J. Sherrington, Heavy Trench Mortar Battery, an employé of Messrs. Dick, Kerr & Co., Ltd., Preston, is in hospital at Leicester, having been gassed in France in July.

Bombardier W. Bingley, R.F.A., formerly in the general office of the India-Rubber Co., Silvertown, has been killed in action, and Sergeant F. Hibbard, R.F.A., formerly in the same department, was wounded on the 17th inst.

Obituary.—Mr. J. F. Cummings.—The *Electrical World* contains an account of the career of Mr. James Fulton Cummings, who died on July 26th, aged 48 years. Mr. Cummings was a Canadian, whose electrical work took him to the United States, and after service with some of the best-known electrical organisations there he developed considerable interests on his own account, in connection with underground conduit and interior conduit work. He sold his American patents and business interests in 1897, and came to London, where he opened a large contracting office in the interest of prominent American manufacturers of conduit material. He carried out important installations of this class in this country, also in Milan, Turin, and Petrograd. His father was the author of the Canadian anthem, "The Maple Leaf for Ever."

Will.—The late Captain John Chamberlain, of Birmingham, left £114,402 gross, and £104,843 net personalty.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wright & Wood, Ltd.—Particulars of £1,000 second mortgage debentures created August 10th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Spensers, Ltd.—Debenture for £3,250, dated July 30th, 1917, to rank *pari passu* with £7,000 first mortgage debentures and a debenture for £750, and in priority to the second debentures.

Bournemouth & Poole Electricity Supply Co., Ltd.—Capital, £500,000 in 25,000 ord., 7,500 4½ per cent. pref., and 17,500 6 per cent. second pref. shares of £10 each. Return dated March 28th (filed July 11th), 1917. 15,000 ord., 7,500 4½ per cent. pref., and 17,500 6 per cent. second pref. shares taken up; £400,000 paid. Mortgages and charges: £187,500.

Telegraph Manufacturing Co. (Colonial), Ltd. (71,854).—Capital, £2,000 in £1 shares. Return dated March 28th, 1917. All shares taken up. £2,000 paid. Mortgages and charges: Nil.

Tudor Accumulator Co., Ltd. (54,080).—Capital, £100,000 in 8,800 "A" and 1,200 "B" shares of £10 each. Return dated August 7th, 1917. 8,800 "A" and 1,200 "B" shares taken up. £10 per share called up on 2,600 "A," and £2 10s. per share on 1,200 "B"; £29,000 paid; £21,000 considered as paid, being £10 per share on 1,200 and £7 10s. per share on 1,200. Mortgages and charges: Nil. A. B. Pescatore, one of the directors, is a native of Luxemburg. All the others are British.

CITY NOTES.

Oxford Electric Co., Ltd.—Interim dividend of 5 per cent. per annum, less income-tax, on ordinary shares for half-year.

Stock Exchange Notice.—Application has been made to the Committee to allow the following to be officially quoted:—

Madras Electric Supply Corporation, Ltd.—100,000 six per cent. cum. pref. shares of £1 each, fully paid.

Companies to be Struck Off.—The following companies are to be struck off the register unless cause is shown to the contrary within three months:—

Advisory Engineers Corporation.
All-British Electrical Co.
Alphons-Custodis Chimney Construction Co.
Fletcher's Electric Fittings.
Fuel Patents Syndicate.
Krupka & Jacoby.
Lighting Supplies.
Magneta Time Co.
Midland Magneto Co.
Ship Carbons.

County of London Electric Supply Co., Ltd.—Interim dividends on the preference shares at the rate of 6 per cent. per annum for the half-year to June 30th, and on the ordinary shares for the same period at the rate of 5 per cent. per annum, both less income-tax.

STOCKS AND SHARES.

Tuesday Evening.

There is a very considerable amount of activity in the industrial market as a whole; and in the animation electrical shares are participating. Not only the electricity supply group is better, but shares in the manufacturing companies are also good, to account for which latter there are interesting rumours afloat. Those whose business leads them into the prosaic paths of stocks and shares are probably in the worst position for judging whether or not such rumours have any truth in them; but, repeating gossip for what it may be worth, report has it that something in the nature of an understanding is on the *tapis* between a number of the best-known British interests and some of the biggest American companies.

These may be too early days in which to do more than hint at the direction which rumour is taking; and, as just observed, the insider connected with the electrical industry is far better able to judge of the possibility of such a combination of interests than the mere financial scribe. But certainly the recent improvement in some of the manufacturing shares is interesting, to say the least of it, in view of the whispers that are current at the moment.

Among the rises in the shares of the electricity supply companies, this week's include ¼ in Metropolitans and ½ in Westminsters, while the half-a-score of rises which occurred last week are well held, and there is a noticeable demand for all the best shares. In the manufacturing group, British Aluminium are noticeably good, and have attracted a really large amount of business at 33s. 3d. Although this shows a rise of no more than 7½d. on the week, the market is a good one, and the improvement follows upon a steady rise within the past two or three months.

Westinghouse preference, too, are firm at 2 11/16, and every day there is a lot doing in the £3 shares of the Ediswan Co. The price, which a little while ago was 10s., has come up to the neighbourhood of 19s.; and it is generally understood that the shares will be split into £1 shares before the end of the year. Being now regarded as £3 shares, this splitting would mean that on the present basis of 19s., the price would be about 6s. 4d.; and having regard to the demand which there is at the present time for any industrial with good prospects, it is thought that the price may easily improve upon the equivalent of its present position. British Insulated have risen 5s. to 13½, following upon their advance of 7s. 6d. last week. India-Rubber 5 per cent. debenture stock at 95 is also harder.

One of our readers asks whether we do not regard India-Rubber shares and Telegraph Constructions as being favourable investments, and our answer is a decided affirmative, though we fear that our correspondent will have some difficulty in picking up the shares. As we have pointed out on previous occasions, the fact that these companies, or any other concerns, have paid in the past their dividends free of tax does not necessarily mean that they will continue the practice in the future, although, of course, they will do all that is possible to maintain the tradition.

The foreign group, with the exception of Brazil Tractions, is also strong. Substantial rises have taken place in Mexican

issues, Mexican Electric Light & Power Common being 12 points up. Big advances have occurred in the various other shares of the company, in Mexico Tramways, and in the Monterey and the Pachuca bonds. Confidence is becoming more assured that President Carranza is really friendly to the Allies and to peace, with the result that nearly everything Mexican has appreciated materially. The rise in the price of silver is a minor factor in the situation.

Brazil Tractions have gone back to 48, the Rio rate of exchange being lower. Anglo-Argentine Tramways are better, the first preference hardening to 2 15/16. There have been big rises in various Canadian industrials, including the light and power issues; and a feature of strength during the past day or two is the activity in Pernambuco Trams, the price having risen a shilling or so to 7s.

The Home Railway market is dull, in consequence of the labour position; but the Underground group keeps fairly steady, by reason of the revision of fares on some of the 'bus routes. This has helped Underground incomes to 83, a rise of ½; but the assented ordinary of the Central London is dull at 60¼.

The telegraph market is firm throughout, with the exception of West India & Panama shares. These eased off to 30s. Eastern ordinary at 145 is harder. Cuba Submarine preference rose 10s. to 14¼. The Marconi group is quiet. Oriental Telephones and United River Plates are both strong. The revival of activity amongst industrials as a whole has somewhat detracted from the allurements of rubber shares; and the market for these has become less animated, though prices are firm. The armament group is quiet. There has been a renewal of activity and better prices in the shares of various mining companies dealing with base metals.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Aug. 28, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6½xd	—	£7 4 0
Charing Cross Ordinary	5	5	8¾xd	—	6 9 0
do. do. do. 4½ Pref.	4½	4½	8¾xd	—	6 19 4
Chelsea	4	3	2½	—	5 4 4
City of London	8	8	13	—	6 3 3
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	11⅛	—	6 3 1
do. 6 per cent. Pref.	6	6	10½	—	5 17 1
Kensington Ordinary	7	6	6½xd	—	5 14 8
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8¾	—	5 6 8
Metropolitan	3	3	3	+ ½	5 0 0
do. 4½ per cent. Pref.	4½	4½	8½	—	7 4 0
St. James' and Pall Mall	8	8	7	—	5 14 6
South London	5	5	9⅜	—	7 5 6
South Metropolitan Pref.	7	7	21/6	—	6 10 3
Westminster Ordinary	7	7	6⅞	+ ⅛	5 9 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	99	—	6 2 5
do. Def.	33/6	1½	22⅞	—	6 16 4
Chile Telephone	8	8	7⅞	+ ⅛	5 11 4
Cuba Sub. Ord.	5	5	8¾	—	5 17 8
Eastern Extension	8	8	14⅜	—	*5 9 4
Eastern Tel. Ord.	8	8	145	+ ½	*5 10 4
Globe Tel. and T. Ord.	7	7	12⅜	—	*5 9 10
do. Pref.	6	6	10⅜	—	5 15 8
Great Northern Tel.	22	24	86	—	6 13 4
Indo-European	13	13	54⅜	—	5 19 3
Marconi	16	16	3⅛	—	4 15 10
Oriental Telephone Ord.	10	10	8¼	+ ⅛	3 4 0
United R. Plate Tel.	8	8	6⅛	+ ⅛	*5 15 4
West India and Pan.	6d.	6d.	1/-	— 1/6	1 12 0
Western Telegraph	8	8	14½	—	*5 10 4
Home Rails.					
Central London, Ord. Assented	4	4	60¼	—1	6 12 1
Metropolitan	1	1	22⅝	—	4 8 6
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	6	4	83	+ ½	*4 16 5
Foreign Trams, &c.	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	2⅜	+ 1/16	9 7 2
do. 2nd Pref.	5½	—	2⅜	—	—
do. 5 Deb.	5	5	67	—	7 9 3
Brazil Tractions	4	4	48	—1	—
Bombay Electric Pref.	6	6	9¾	—	6 4 8
British Columbia Elec. Ry. Pfce.	5	5	47½	—	10 10 6
do. do. Preferred	Nil	Nil	81	—	Nil
do. do. Deferred	Nil	Nil	29	—	Nil
do. do. Deb.	4½	4½	55	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	49½	+5	Nil
do. 6 per cent. Bonds	Nil	Nil	83½	+3	Nil
Mexican Light Common	Nil	Nil	30	+12	Nil
do. Pref.	Nil	Nil	82¼	+3	Nil
do. 1st Bonds	Nil	Nil	59	+4½	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3½	—	4 15 10
British Aluminium Ord.	7	10	1¾	+7½d	6 1 3
British Insulated Ord.	17½	20	12½	+ ½	7 8 3
British Westinghouse Pref.	7½	7½	2½	—	5 11 6
Callenders	20	20	14½	—	7 0 6
do. 5 Pref.	5	5	4½	—	6 1 3
Castner-Kellner	22	22	3⅛	—	6 8 0
Edison Swan, fully paid	—	—	1½	+ ⅛	Nil
do. do. 4 per cent. Deb.	4	4	71½	—	5 12 0
Electric Construction	7½	7½	¾	—	8 0 0
Gen. Elec. Pref.	5	5	10½	—	5 17 1
do. Ord.	10	10	16	—	6 5 0
Henley	25	25	16	—	7 16 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	13½	—	*7 6 10
Telegraph Con.	20	20	38½	—	*6 5 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, August 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£54	..
a Bisulphide of Carbon	"	£38	..
a Borax	"	£38	..
a Copper Sulphate	"	£61	..
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	3/-	..
a Shellac	per cwt.	£12 10	20/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	"	£35	..
a " Lump	"	£25	..
a Soda, Chlorate	per lb.	10½d.	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2' to 12' basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/7½ to 1/8½	..
g " Bars (best selected)	per ton	£160	..
g " Sheet	"	£160	..
g " Rod	"	£160	..
d " (Electrolytic) Bars	"	£157	..
d " " Sheets	"	£162	..
d " " Wire Rods	"	£145	..
d " " H.C. Wire	per lb.	1/6½	..
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/3	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2½	..
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
f " Wire, galv. No. 8, P.O. qual.	"	£42	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 2/-	..
e " " " medium	"	2/6 to 6/-	..
e " " " large	"	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/9½	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	2/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Energy Released by Boiler Explosion.—Writing in *Power*, Mr. C. H. Berry, Assistant Professor of Power Engineering, Cornell, gives an explanation of the very destructive effect of boiler or economiser explosions, though only moderate working pressures are employed.

Referring to the explosion of a cast-iron economiser, he points out that the displacement of the atmosphere must have been responsible for the displacement of 5,000 sq. ft. of roof, and injury to buildings, &c., as flying fragments of iron would not account for this. The resistance of the atmosphere and sudden movement—its inertia—tends momentarily to blanket the sudden expansion; but this phase passed, and the air is set moving violently, tending to keep moving and thus piling a high pressure against any obstructing object, much as in the case of "water hammer" action.

The work done in moving the atmosphere cannot be measured as a product of its pressure by any change of volume, since this is not a slow pushing back of the surrounding medium, but a sudden movement which necessarily does much work in developing a high velocity of the air.

Since the velocity and the weight of air moved are unknown, it is not possible to compute the energy required to overcome the resistance. Prof. Berry therefore decides that it is impossible to make deductions from the energy liberated on account of atmospheric resistance.

Electrification of Swiss Federal Railways.—The United States Consul at Berne reports that the electrification of the Swiss Federal Railways has now emerged as a very practical economic question. The Government has created a special department, attached to the direction of the Swiss Federal Railways. This department announces that it is prepared to consider proposals for sale and delivery of such electrical material as may be necessary for equipment in connection with this work, and that bids will be received from all countries. A statement by the management shows that large orders for copper wire already have been placed with certain firms in the United States.—*Electrical World.*

SOME NOTES ON BRITISH AND CONTINENTAL ENGINEERING METHODS AND TRAINING.

By A. G. ELLIS, A.M.I.E.E.

(*Abstract of lecture delivered before the* British Westinghouse Engineers' Club.)

At no time in history has there been so much discussion of British industrial and trading methods as compared with those of our Continental neighbours, both allied and (chiefly) enemy, which differ in many points from ours. I have endeavoured in these notes to bring out a number of such points which I have observed during several years of engineering work on the Continent.

General Industrial Conditions.

Living and Wages.—Living is, on the whole, rather cheaper on the Continent, but wages and salaries are correspondingly lower. Skilled manual workmen in the engineering trades earn only about 75 per cent. of the hourly rates of corresponding trades in this country. In spite of this, the general conditions of living are better, and thrift is much more observable than among the manual workers in this country.

This is in many cases partly to be attributed to the natural environment and situation of the factories. Only in the largest industrial centres of France and Germany does one meet conditions approaching the congestion and monotony of English manufacturing districts. Apart from these, factories are located individually, or in small groups, in or adjacent to medium-sized towns, from which egress into the surrounding country is an easy matter.

This question of environment has undoubtedly its effect on the *morale* and life of the manual workers, which is especially noticeable in the industrial districts of Switzerland. In that country, partly by reason of the brighter environment, and partly because of the innate democratic nature and the national educational system, the manual workers are remarkably thrifty and independent, and in general living are very simple and hygienic.

The same ends (apart from independence) are reached in Germany, for instance, by means of official inspection and control.

An important factor in this question is that of housing. On the Continent nearly everyone, including the manual workers, live in flats, built in blocks of usually three to five stories with common gardens behind. Central heating and electric lighting are common, and rooms larger and better arranged than in the orthodox five- or six-roomed small house are obtained. Such blocks do not generally suffer from the depressing "soullessness" of the working people's tenement dwellings found in the industrial cities in England.

There is also a greater tendency among the working people to build their own dwellings, which is fostered and assisted by the popular banks, who make a practice of lending money for such purposes at low rates of interest.

Relations of Capital and Labour.—In every European country there continually arise practically the same questions between Capital and Labour. In general, the relations between the two parties appear to be more cordial the more democratic the country, and, conversely, the more difficult the more autocratic the country.

To take two extremes: In Germany, Socialism is strong and discontent is fairly rife among the manual workers, but it rarely gets under way owing to being kept down under the iron heel of militarism; in Switzerland, on the other hand, democracy is advanced to such an extent that employés are often shareholders in the industrial concerns they are working with, and there is seldom, and little, industrial discontent.

Trade Unions exist in all the industrial countries, but they are usually wrapped up in Socialistic propaganda, and are generally not nearly so powerful as in England.

Technical Staff.—Salaries of the technical staff are also rather lower than in England, but living and travelling are cheaper. For young, single engineers life is less of the dreary proposition it often is in England, as good apartments are more readily obtainable, and more generally developed restaurant life renders the restaurants and "Bier-halle" very habitable places. At least one of the large European firms has built a colony of houses for its staff and their families, which are let out as single villas, or as two or three flats at moderate rentals.

The lower scale of salaries is partly due to the over-production of university-trained engineers in Germany during the past 10 to 15 years. This has led, incidentally, to a better class of man, technically, being available for intermediate and lower positions, such as draughtsmen, test assistants, &c.

The bonus system has been generally in vogue for a good many years, with satisfactory results. The actual amount is determined by the individual work accomplished, initiative, and personal relations with other departments and individuals.

Rents, Rates, and Taxes.—On the whole, the sum total of house rent, rates, and taxes approximates to the same figures as in England, though living, travelling, and amusements cost generally rather less.

Working Hours.—The total number of working hours per week for workshops and offices is approximately the same in England and on the Continent. Works hours for manual workers total 52-53 hours per week, and office hours average 45 hours per week. Up till recent years it was quite common practice to work right through Saturday afternoon, and this practice has never been abandoned or relaxed in France. This is not without its influence on the physique and *morale* of the race. The British traditional Saturday afternoon of sport is, on the whole, much more beneficial, even to working capacity, in the long run.

General Works Organisation.

Relation of System to Size of Firm.—Up to a certain point the organisation on any industrial undertaking is practically the same anywhere. There are usually three main divisions:—

1. The technical side, comprising engineering, design, and manufacture.
2. The sales side, comprising selling, publicity departments, &c.
3. The commercial side, comprising the accounting, purchasing, and similar departments.

Beyond this point the organisation depends to a large extent upon the size of the undertaking and the number of employés.

Small Continental firms generally have the whole of the engineering work grouped together in one common design office and one general drawing office. This is the most workable and efficient plan for small undertakings. In the larger Continental firms it has been found necessary to sectionalise the departments according to the class of machine or apparatus manufactured.

The sales departments are also similarly grouped in the general sales office in the case of small firms, and sectionalised according to the different classes of machinery in large firms, the necessity for which is obvious when dealing with large amounts of business.

Comparison of British and Continental Practice.—Turning now to British organisation of medium and large firms, we find a compound of the above two systems. In a typical organisation, certain specialised departments, such as traction, transformers, and apparatus, are segregated from the main engineering departments, while others are left collectively under the general engine and machine departments. This segregation is carried out for the same departments on the sales side, the engineering and sales divisions being located in close proximity, and working in close co-operation. This point is a step in advance of the organisation adopted by large Continental firms, and I should say it forms the most satisfactory basis for the organisation of a large works.

Probably the most efficient working would be obtained by also sectionalising the factory as far as possible into a number of component factories producing each one class of machine or apparatus, under the control of the corresponding engineering unit working in conjunction with its own sales department.

The standardising department prepares lists of all standard materials, parts, tender and specification forms, &c., and the department chief is charged with lining up the general practice of, and ensuring co-operation between, the several engineering departments, to prevent unnecessary waste and overlapping. This is of great importance in reference to economising on stocks and sizes of frames, copper, angle irons, &c., and it is, in fact, a very live department if properly organised. It is not sufficient that a certain amount of necessary standardisation of parts and stocks common to all engineering departments has been done once and for all, but it is essential continually to line up progress in all the different departments, and thus reduce development expenses by preventing overlapping.

Research.—Research departments are not far developed in other than a few of the leading engineering works. In general, research work is conducted on much the same scale and in much the same way as in England. A large amount of investigation is carried out at the technical high schools and universities, but this often suffers from the common complaint of being too academical. In the engineering works, though the largest firms have their own research laboratories, this work is not carried on on anything like such a lavish and far-reaching scale as in America. What is missing on the Continent, as in this country, is a comprehensive scheme of co-operation for the systematic carrying-out of research work, and distributing the results and preventing overlapping and repetition.

Weights and Measures.—The advantages of the metric and decimal system of weights, measures, and money in universal use on the Continent are nowadays sufficiently apparent to be past controversy.

In this country our conservative clinging to unwieldy and cumbersome systems of weights and measures handicaps our business in foreign markets, and is responsible for considerable waste of time and many errors, particularly in engineering work.

The influence of Continental engineers who have been employed in responsible positions by British firms is observable in some quarters in a mixture of metric and British units

in calculation and design work. Such a state of affairs is, if anything, more hopeless than sticking to one system, however bad.

Another point I would make is that of ease of conception of magnitudes in the metric system. Small magnitudes are expressed in millimetres, and the magnitude of the millimetre becomes a clear and fixed quantity to the mind and to the eye.

In general, I believe that the presumed difficulties in changing over and getting used to a new and rational system, even for the man in the street and the old woman in the market, would be found not nearly so insurmountable as has been supposed. The sweeping changes in national ideas and conventions since the war have demonstrated the rapid adaptability of the British national mind, and, in addition, the influence of closer contact with the Continental nations since the war renders the present time (or the immediate after-war period) very suitable for such a change.

Relations between Manufacturers and Customers.—General business relations, conditions of sale, terms of payment, &c., do not differ to any extent in most of the Continental countries from those obtaining in this country. Technical relations between manufacturers and customers, however, differ considerably, being more co-operative on the Continent than in England.

Industrial Banks.—The first reason for this is that a large part of the engineering business for the Continental market is conducted through the industrial banks which finance industrial concerns and power schemes, ensuring a market for their manufactures.

The largest German electrical and manufacturing concern is conducted on these lines, this undertaking comprising not only machine factories and power schemes, but also mines and factories for the internal supply of raw material. Under such conditions, a large demand for manufactured machines is automatically created, which facilitates production in large quantities (massenfabrication), which, with the cheap supply of raw material, results in low cost of production and consequent easy competition in the open markets. This has been one of the important factors underlying German competition in the world's markets.

In concerns financed by subscribed capital, and not by the industrial banks, there are also instances of correlated power companies who finance and engineer large power schemes, for which the necessary machinery and apparatus is automatically ordered from the mother manufacturing company. This ensures a certain minimum "load factor" of works production at reasonable prices.

Consulting Engineers.—The second reason for the closer co-operation between manufacturers and customers is the practical absence on the Continent of the consulting engineer. This is chiefly due to the method of conducting affairs referred to immediately above. By reason of this, the consulting engineer has become practically short-circuited and superseded by skilled engineers on the staffs of the manufacturing and power-scheme companies who are, as a matter of fact, more intimately in touch with the conditions obtaining and manufacturing possibilities. The result is certainly beneficial, and leads to closer co-operation and sounder engineering work.

Standardisation.—Closely related to this question is that of standard specifications and standard apparatus. In this country it appears that practically every individual consulting engineer and power company issue their own pet specifications for electrical machinery, and seldom are content with the manufacturers' standard apparatus. Even the Standardisation Rules of the Engineering Standards Committee appear to be specified only in the minority of cases. Apart from the question whether these rules represent the most desirable set of specifications, it is to be deplored that they should not be more widely adopted by purchasers of electrical machinery.

The lack of uniformity in different customers' requirements (the difference often being of relatively little importance) necessitates manufacturing numbers of special types of apparatus, resulting in needless loss of time in offices and works, and increased cost of production.

On the Continent, the state of affairs is just the reverse. Each country of importance has its own set of standardisation rules, issued by an authoritative body representing the industry.

The German rules for electrical machinery (issued from year to year by the V.D.E., corresponding to our I.E.E.) are adopted by all the German, Austrian, and Swiss firms, and most of the rules of other countries (among them France, Belgium, Russia, and Italy) follow them very closely. The consequence is a fairly uniform specification throughout Europe, as the standardisation rules are *respected* and worked to by practically all manufacturers and customers' engineers.

The manufacturers are thus in a position to standardise and get out lists of their apparatus in accordance with the standardisation rules, and they are sufficiently strong to compel the customer to accept their standard apparatus, or go elsewhere—if possible.

This is the fundamental difference between this country and the Continent in this important matter. I know of one instance where a Continental manufacturing firm some years ago gave up the idea of English business, in spite of the "open door," solely on this account.

Electrical Machinery for British and Continental Markets.—I will only refer to the three principal specification conditions for electrical machinery, viz.:—

(*a*) Temperature rise.
(*b*) Overload capacity.
(*c*) Insulation tests.

(*a*) and (*b*). In the matter of temperature rise there has been a certain amount of timidity in this country. The general figure for the temperature rise of electrical machinery at continuous normal load on the Continent is now 60 deg. C., while according to the British standard rules it is 50 deg.–55 deg. C.

Here we still find many different individual customers or consulting engineers each specifying a different temperature rise, ranging from 30 to 50 deg. C., and often after varying periods of time. The usual reason given is the different degree of overload required, according to the duty the machine has to perform, some preferring what they call a "liberally rated" machine.

This leads also to a variety of specifications as regards overload capacity. The most rational way to designate a machine is by its *normal continuous rating at the standard temperature rise*, for which rating standard overload capacities are available. The size of machine can easily be selected by determining the permissible normal rating in conjunction with the overload capacity required. In the case of machines for varying load (crane, rolling mill, traction motors, &c.) the normal rating should be determined from the root-mean-square value of the load diagram.

(*c*) As regards insulation tests there is less discrepancy of ideas in the different countries. This uniformity is at least gratifying, but it prompts the question why we should not be able to establish *international* standards. There is, after all, little radical difference between British and Continental machinery (electrical or otherwise), and it is to be hoped that in the course of time the International Electrotechnical Commission will be able to achieve something in this direction.

Tolerances.—In the various standardisation rules I find no standard tolerances to guarantees specified, although it is not uncommon for manufacturers to demand such, both on the Continent and in this country.

Most of the large Continental firms have these tolerances scheduled and prescribed in their standard lists. There have been cases of a firm utilising part of the tolerance in order to present apparently better guarantees than correspond to reality, a practice which is to be deprecated.

General Applications of Electricity.—In the utilisation of electrical energy for factories, mills, shipyards, public lighting and tramways, and suburban railways, we are as far as, and in some cases further advanced than, on the Continent. Main-line electrification has, however, gone ahead quicker across the Channel, notably in Italy and Switzerland.

A good deal might be done in this country on Continental lines in the more general domestic application of electricity, partly as an aid to the solution of the servant problem. On the Continent the use of electricity for village lighting, cooking and heating, and driving of looms and machines for home industries is very widely developed. The application of electricity to agricultural machinery, at any rate in the mid-European countries, is also far developed.

It is usually thought that this is the outcome of cheap electrical energy being obtainable from the large sources of water power available. So far as I have seen, electrical energy is not, on the whole, very much cheaper on the Continent than in this country, and against this must be taken into consideration the fact that wages are generally lower.

The domestic use of electricity is facilitated by the simplicity of house and shop wiring, covered wires being run on porcelain cleats on walls and ceilings without casing or tubing; also by the ease in connecting-up small consumers to the distributing networks, which are usually bare overhead wires on wood poles in the smaller towns and villages.

Of course, we have been handicapped to a certain extent by being pioneers, and also by the Board of Trade limit of 20,000 volts transmission voltage.* It is to be hoped that the after-war period of development will see the removal of this limit, and the development of high-tension overhead transmission.

Training of Engineers and Manual Workers.—It is generally reckoned that the educational system of the majority of the European countries is more highly developed than in England. The chief point of contrast is the continuous national system, from the primary school to the University, usually found on the Continent. While in England individual sections of our educational systems, notable the public schools and universities, do not show up at any disadvantage, there is a serious handicap in lack of continuity throughout the whole system.

Training of Skilled Engineers.—For the training of skilled engineers the Continental system follows the invariable course of primary school, intermediate school, technical preparatory school, technical high school or university. Attendance for a prescribed number of years in each is obligatory in order to become a diploma engineer.

In this country a youth is taken straight from a secondary or public school to a technical college or university without any preliminary technical education. The result is that a large amount of technical ground has to be covered during the first year, at such a rapid rate, that it is difficult to assimilate it properly; nevertheless, it is remarkable how

rapidly English students pick up and progress during the remaining years of study.

The English engineer is finished sooner than the Continental, and at the age when the latter has finished his studies and works experience the former has already had several years of valuable practical experience, and is of more use to the industry, and a better man for his job. This often shows itself in the young engineers in England being more practical, and on the Continent being more academic.

On the whole, the finished product of the British technical college or university shows up quite favourably against the Continental. This statement must, however, be qualified for the partially-trained men in intermediate positions.

On the Continent there is generally more or less systematic training to be obtained for draughtsmen, test assistants, erection engineers, and the like, for whom no specific course of education obtains in this country. On the Continent such positions are usually filled by men designated "Techniker," usually drawn from the more intelligent artisans and trade apprentices, who spend two complete years at a technical school, the "Technikum." This school is not of university rank, and men who have taken its courses do not rank as engineers, though a certain number attain to positions usually filled by university-trained men. So far as I have seen, the average level of capability and intelligence of draughtsmen and the like is thereby greatly enhanced.

Training of Manual Workers.—The trade apprentice usually enters works at about the age of 14 years, as in this country, and continues his education systematically at the national schools in subjects connected with his particular trade. These classes are compulsory for regular trade apprentices, and are held during working hours on several afternoons of each week, the apprentices being granted the necessary leave to attend them regularly.

It is only of recent years that attempts have been made in this country to secure continuation schooling for trade apprentices during works hours, and this has been by individual effort. On the Continent, such schemes have been in vogue and under national supervision for many years, and the beneficial results are apparent.

A proper scheme of apprentice training should be incorporated in a reorganised national system of education in England, under the central education authority controlling a continuous scheme of education up to the technical colleges and universities.

SECOND REPORT OF THE COMMITTEE FOR THE INTERCONNECTION OF THE LANCASHIRE AND CHESHIRE ELECTRICITY SUPPLY SYSTEMS.

(*Concluded from page* 191).

49. The total capacity expended by municipalities on power stations, mains, and sub-stations in the area covered by this report is £7,425,266, of which £3,166,274, equal to 43 per cent., has been paid into the sinking fund, and the outstanding capital indebtedness is £4,339,183.

In addition to the amount paid into the sinking fund, there stands to the credit of reserve and renewals funds a total of £337,672.

The capital expenditure of companies on power stations, mains, and sub-stations amounts to £1,341,690, of which £126,567, equal to 9 per cent., has been written off.

50. A joint board, constituted on the lines set forth in Clause 4, consisting of nominated or elected representatives of all the statutory authorities in the area, together with an advisory committee of engineers, would, in the opinion of the Committee, form the most suitable authority to exercise full statutory powers in regard to all power stations and transmission lines in the area of Lancashire and Cheshire.

These representatives and engineers have for many years had a close and intimate knowledge not only of the possibilities of economical production from the supply authorities' point of view, but also of the requirements of the various industries established in the district.

A board so constituted might be relied upon to furnish the necessary enterprise to develop the power supply business in the best interests of the industrial community.

51. In Lancashire and Cheshire the majority of electricity undertakings are owned and operated by municipal authorities. Amongst these undertakings are some of the largest and best-equipped stations in the country, and the prices charged for industrial purposes compare favourably with the lowest charges made elsewhere. There would appear to be no valid reason, therefore, why the present measure of control by municipalities should be disturbed in setting up the constitution of the joint board, the important point being to constitute one single authority for the whole area so that future developments can be co-ordinated along sound, technical, and commercial lines.

52. The Committee feel that the time has passed when power to generate electrical energy, which is so vital to the interests of the trade of the nation, and to the efficient employment of the nation's principal source of wealth, *i.e.*, coal, should continue to be exercised solely for the purpose of supply within a limited area, and, in order to deal efficiently with future requirements, they consider it essential that extensions of existing power stations or the provision of new power stations should only be proceeded with after due consideration has been given not only to the requirements of the particular area in which such power stations may be situated, but also of the actual or potential requirements of the surrounding districts. In other words, the provision of efficient generating plant has ceased to be a matter which only concerns each separate undertaking as at present constituted, but has become an important element in the welfare of whole districts, without regard to municipal or other boundaries.

53. In order to secure the most efficient results, developments should take place along the following lines:—

(*a*) Large units of plant—of not less than, say, 10,000 KW. to 15,000 KW.—must be provided in order to obtain the most economical employment of capital expenditure.

(*b*) Such plants must be concentrated in the most suitable localities for the purpose.

(*c*) High-tension transmission lines for interconnecting purposes must be constructed between the large power stations, so that the large plants may be used to the greatest advantage.

(*d*) All suitable sources of waste heat must be utilised.

By effecting these changes not only would there be a considerable reduction in the annual costs incidental to a lower capital expenditure per KW. of plant installed, but there would be an enormous saving in the fuel consumption per unit generated, in addition to reductions in other working expenses.

54. The Committee would point out that under these proposals supplies would be given to authorised distributors at cost prices, and, whilst reserving to the authorised distributors their full and existing rights under their provisional orders, it may be necessary to introduce safeguards to ensure that the advantages of cheap production arising out of a federation of interests shall not be neutralised by the distributing authorities charging unduly high prices to the consumers within their area.

The Relation of the Joint Board to the Existing Government Departments, or to any New Electricity Tribunal that may hereafter be set up.—55. The Committee are in accord with the recommendation tendered to the Board of Trade Electrical Trades Committee, advocating the appointment of a new tribunal consisting of a limited number of electricity commissioners, who would be entrusted with the jurisdiction of matters affecting the supply of electricity.

56. The Committee would go further, and suggest that the commissioners should be the central authority in technical matters, and should possess all other powers now exercised by Government departments, and such other powers as may hereafter be conferred upon them by Parliament, with regard to electricity supplies for the *whole* country.

57. The establishment of the one single authority referred to above for owning and operating the power stations and high-pressure transmission lines in the Lancashire and Cheshire area does not appear to the Committee to be inconsistent with the proposal to set up electricity commissioners.

58. On all technical matters the advisory committee of engineers to the joint board would form the medium of relationship between the central authority of the electricity commissioners and the local joint board.

Summary of Committee's Further Recommendations.—59. Inasmuch as the interconnecting proposals are but the preliminary steps in the direction of co-ordinating the existing undertakings, the Committee would strongly recommend that favourable consideration should be given to the proposals set forth in the latter sections of the report, namely:—

That in addition to the powers conferred upon the joint board (as set forth in Clause 7) for the purpose of interconnection, the board should also possess powers enabling them to erect new power stations and to acquire—when and where desirable—the ownership, control, and operation of all or any power stations (existing and future), and all high-pressure transmission lines.

60. That a new tribunal, consisting of electricity commissioners, should be set up to administer the powers now exercised by Government departments in relation to electricity supplies, and such other powers as may hereafter be conferred upon them by Parliament.

61. *Note.*—The signatories to both sections of this report wish to make it quite clear that the recommendations and suggestions contained in the report represent their own personal opinions, and do not necessarily represent the views of the respective undertakings with which they are connected.

S. L. Pearce, *Chairman.*
B. Welbourn, *Vice-Chairman.*
J. A. Robertson, *Hon. Secretary.*
S. E. Britton,
H. Dickinson,
S. J. Watson,
P. P. Wheelwright,
W. J. H. Wood,
Members of the Committee.

July, 1917.

Sir John A. F. Aspinall, Mr. Edwardes, and Mr. Purrett do not sign this section of the report, owing to the position that would be created for their companies if the foregoing proposals were given effect to.

Mr. Blackmore does not sign this section of the report, as he is not in agreement with the proposals to invest the joint board with the following powers:—

1. The purchase of the existing power stations owned by the municipalities.

2. The purchase of the undertakings owned by the companies.

3. The erection of new power stations.

Schedules attached to the report contain the following particulars relating to the method employed in determining bulk and reciprocal supply costs:—

BULK SUPPLY COSTS AT BUS-BARS OF STATION SUPPLYING.

Load factor 30 per cent.

(*a*) CAPITAL CHARGES.

	Per KW.D.
Cost of installing complete plant, using modern sets of not less than 5,000 KW. ...	= £10 at continuous rating.
Depreciation or sinking fund	= 5 per cent. per annum on 16 years, average life of assets.
Interest	= 5 per cent. per annum.
Total charges on capital ...	= 10 per cent. per annum.
10 per cent. on £10 ...	= £1 per KW.D. per annum.

(*b*) WORKING EXPENSES. (Generation.)

Coal (stand-by) ... ...
Oil, waste, water, and stores
Wages and salaries ... ...
Repairs and maintenance ...
Management ... ...
} = £1 6s. per KW.D. per annum.

Rates and taxes excluded.

(*c*) COAL. (Running.)

At 17s. 6d. per ton = ·168d. per unit delivered to feeders.

Provision should be made for a variation in the price of fuel, viz., ·0014d. per unit corresponds to an increase or decrease of 1d. per ton.

Note.—In the fuel costs is provided a sum sufficient to cover the removal and disposal of ashes.

(*d*) SUMMARY OF COSTS.

	Per KW.D. per annum.
Fixed charges.—Capital charges	£1 0 0
General working expenses ...	1 6 0
	£2 6 0
Running charges.—Coal	·168d. per unit delivered to feeders.

The following additions and deductions are suggested for load factors other than 30 per cent.:—For a load factor of 50 per cent. and over, a deduction of 5s. per KW.D. per annum; 45 per cent., but under 50 per cent., a deduction of 3s.; 40 per cent., but under 45 per cent., a deduction of 2s.; 35 per cent., but under 40 per cent., a deduction of 1s.; 30 per cent., but under 35 per cent., basic charge; 25 per cent., but under 30 per cent., an addition of 2s.; 20 per cent., but under 25 per cent., an addition of 6s.; 15 per cent., but under 20 per cent., an addition of 14s.; 10 per cent., but under 15 per cent., an addition of 22s.; below 10 per cent., an addition of 34s.

Over-all costs per E.H.T. unit at station bus-bars, with coal at 17s. 6d. per ton, for varying load factors:—Load factor of 50 per cent. and over, ·280d.; 45 per cent., but under 50 per cent., ·298d.; 40 per cent., but under 45 per cent., ·318d.; 35 per cent., but under 40 per cent., ·344d.; 30 per cent., but under 35 per cent., ·377d.; 25 per cent., but under 30 per cent., ·430d.; 20 per cent., but under 25 per cent., ·524d.; 15 per cent., but under 20 per cent., ·715d.; 10 per cent., but under 15 per cent., 1·100d.; below 10 per cent., 1·440d.

RECIPROCAL SUPPLY COSTS—LIGHT LOAD PERIODS.

30 per cent. load factor.	Per KW.D. per annum.
(*a*) 33⅓ per cent. of the capital charges	£0 6 8
(*b*) 25 per cent. of the general working expenses ...	0 6 6
Total	£0 13 2

(*c*) Running charges with coal at 17s. 6d. per ton = 0·168d. per unit delivered to feeders.

Subject to the same provision for a variation in the coal price as in the case of bulk supplies.

For load factors other than 30 per cent., the corresponding values given for bulk supply "capital charges" and "general working expenses" would be taken, but the above percentages of 33⅓ and 25 per cent. would still apply.

Manganese Dioxide in Canada.—A message from Calgary, Alberta, to the Central News, says that practically inexhaustible deposits of manganese dioxide have been found in the Cypress Hills, in South-East Alberta. Eight hundred thousand tons, worth approximately £11,000,000, have been blocked out in the last few months. The manganese lies at the surface of the ground, and, therefore, the deposits are very easily worked. The staff of the Department of Mining of the University of Toronto have discovered a process by which low-grade concentrates of molybdenite can be made at little cost. The new process will render available the deposits of low-grade molybdenum ore which have been discovered in Manitoba and British Columbia.—*Financial Times.*

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

11,607. "Electrical measuring instruments." R. D. GIFFORD AND NALDER BROS. & THOMPSON. August 13th.

11,658. "Apparatus for concentration of electric waves in a single direction or upon a fixed point." E. BINETTI & L. ROTA. August 14th.

11,659. "Electric heating devices." R. K. HEARN. August 14th.

11,660. "Electromagnetic friction clutches." W. LANGDON-DAVIES & A. SOAMES. August 14th.

11,669. "Device for indicating electrical leakage in insulation of sparking plugs." A. E. LAMKIN. August 14th.

11,677. "Starting apparatus for electric motors." G. LAYTON. August 14th.

11,765. "Selective signalling systems and selectively operable devices therefor." WESTERN ELECTRIC CO. (Western Electric Co., U.S.A.). August 16th.

11,777. "Producing electricity and mechanical power by permanent magnets." D. SUCHOSTAWER. August 16th.

11,785. "Variable electric resistances." W. E. BAKER. August 16th.

11,791. "Sparking plugs for ignition in internal-combustion engines." K. E. L. GUINNESS. August 16th.

11,806. "Electricity generating plant." O. STOTT. August 16th.

11,830. "Electric annunciators." AUTOMATIC TELEPHONE MANUFACTURING CO. & S. R. SMITH. August 17th.

11,839. "Trolley heads of electric tramways." W. H. COTTER & R. H. HOLLINGSBEE. August 17th.

11,860. "Ignition magnetos." A. R. J. FOSTER. August 17th.

11,862. "Electric furnaces." W. B. LAKE. August 18th.

11,864. "Telephone receivers, &c." A. MARR. August 18th.

11,867. "Heating conductors of thermic telephones." NAAMLOOZE VENNOOTSCHAP DE NEDERLANDSCHE THERMO-TELEPHOON. August 18th. (Holland, September 15th, 1916.)

11,883. "Art of stereotyping, electrotyping, &c." J. THOMLINSON. August 18th.

11,878. "Telegraph systems." AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., & H. H. HARRISON. August 18th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

5,947. WIRE-DRAWING MACHINES. H. A. Marvin. May 4th, 1915. (100,308.)

10,402. ELECTRIC IGNITION ARRANGEMENTS FOR INTERNAL-COMBUSTION ENGINES. H. R. Wright. July 24th, 1916. (108,183.)

10,573. ROTATABLE CONTACT-BREAKERS FOR MAGNETOS AND OTHER PURPOSES. E. J. Pilblad. July 26th, 1916. (108,194.)

10,626. SLIDE-RULES FOR USE IN WIRELESS TELEGRAPHY CALCULATIONS. A. J. Martin. July 27th, 1916. (108,197.)

10,721. MAGNETOS AND LIKE ELECTRIC MACHINES. W. O. Kennington. July 28th, 1916. (108,203.)

11,100. ELECTRICAL SIGNALLING APPARATUS FOR USE IN MINES AND FOR OTHER PURPOSES. H. R. Waddington & I. H. Parsons. August 7th, 1916. (108,213.)

11,982. SPARK PLUGS. J. J. Platt. August 23rd, 1916. (108,220.)

12,704. APPARATUS FOR PRODUCING UNIDIRECTIONAL ELECTRIC CURRENTS OF A POTENTIAL SUFFICIENTLY HIGH TO OPERATE X-RAY TUBES. F. Richer. September 7th, 1916. (108,226.)

13,269. ART OF ELECTRICAL SIGNALLING. G. O. Squier, L. W. Austin & L. Cohen. September 19th, 1916. (108,230.)

13,285. SEARCHLIGHT IN COMBINATION WITH A GUN FOR USE AGAINST AIRCRAFT. A. J. Reynolds. September 19th, 1916. (108,232.)

13,390. ELECTRIC POCKET LAMPS, ELECTRIC TORCHES AND THE LIKE. E. A. Bellow. September 21st, 1916. (108,234.)

13,803. ELECTRIC MOTOR CONTROL. British Thomson-Houston Co. (General Electric Co., U.S.A.). September 28th, 1916. (108,237.)

14,643. ELECTRIC INCANDESCENT LAMPS FILLED WITH ARGON. Allgemeine Elektricitats Ges. November 11th, 1915. (102,141.)

14,991. APPARATUS FOR BENDING AND SHAPING WIRE. British Thomson-Houston Co. (General Electric Co., U.S.A.). October 21st, 1916. (108,246.)

15,561. ELECTRIC ARC LAMPS. A. H. Railing & A. E. Angold. November 1st, 1916. (Addition to 16,694/15.) (108,252.)

16,512. IGNITION DYNAMOS. C. T. Mason. June 19th, 1915. (Divided application on 8,584/16.). (102,265.)

17,987. IGNITION DYNAMOS. C. T. Mason. January 7th, 1916. (103,291.)

1917.

1,578. METHOD OF ELECTRICAL EDGE-WELDING. T. E. Murray. March 2nd, 1916. (104,504.)

1,678. PORTABLE ELECTRIC HAND LAMPS AND THE LIKE. N. McLean. February 2nd, 1917. (108,270.)

2,809. REGENERATIVE BRAKING SYSTEMS FOR ELECTRICALLY-DRIVEN VEHICLES. W. V. Turner & T. H. Thomas. September 6th, 1916. (Addition to 103,959.) (108,276.)

4,370. ELECTRIC IGNITION DEVICES. W. O. Kennington. April 19th, 1916. (105,908.)

4,644. MAGNETOS. W. L. Gullette and C. A. Vandervell & Co. March 30th, 1917. (108,281.)

5,825. CENTRIFUGALLY-ACTUATED SHORT-CIRCUITING DEVICES FOR DYNAMO-ELECTRIC MACHINES. British Westinghouse Electric & Manufacturing Co. May 3rd, 1916. (106,484.)

5,929. OZONISERS. W. S. Graff-Baker. April 26th, 1917. (108,293.)

Tramway Workers: Wage Awards.—The August issue of the *Journal* of the Tramways and Light Railways Association contains particulars of a number of awards recently made by the Committee on Production affecting different classes of tramway workers.